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Issue #140 August/September 1988

Update

'88



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**Daniel P. Bierman, Jr.
ESB, Electronic Service, Inc.
Billerica, MA**

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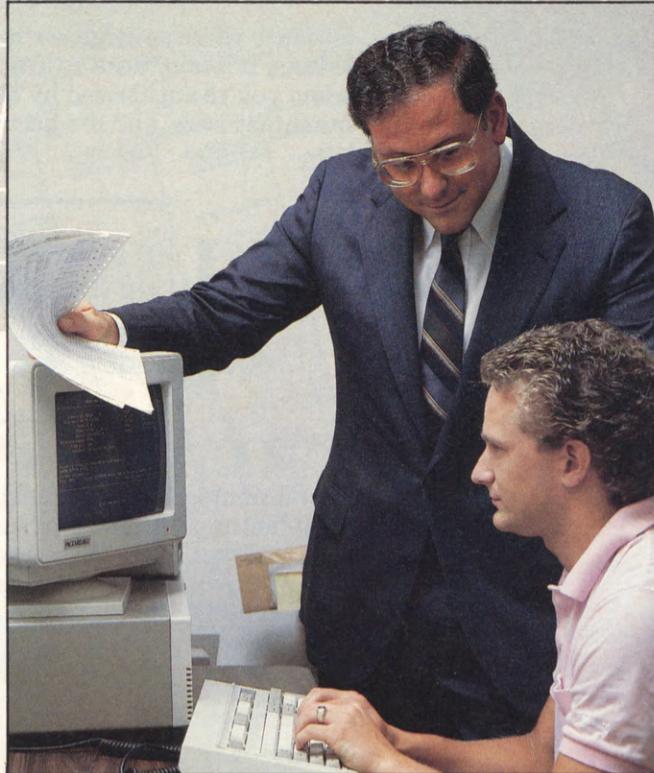
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You Can Make Your Business Grow With These Proven Success Methods

by Daniel P. Bierman, Jr., ESB, Electronic Services, Inc., Billerica, MA

When Dan Bierman bought the company, his 500 sq. ft. shop had 5 employees and earned \$100,000 per year. Six years later... Dan's operation includes 85 employees and earns \$3,000,000 per year.

Editor.

As we expand into more divisions, I see Sencore as a major part of what we do.

Our company was founded in 1969 so I guess you can say we've been in business almost 20 years. I bought the company six years ago when it was a small shop. At that time you could stereotype it, it was a corner TV shop with two technicians and three office workers, a typical situation. Six years later, we have 85 people — close to 50 technicians. To understand our position, might be to say we have accelerated through many phases over the past six years!"



Fig. 1: There was a tremendous lack of quality service caused by the growth of the VCR, Camcorder, TV and CD markets.

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Go Back To The Basics Of How To Treat People And Treat Your Service As A Product

I believe what I did for service, not being from a service background, but from a business background, was to take what I have learned and treat service, not like a service company but more like a business. I went back to the basics of how to treat people. That's really the key in any business, how one interacts with the public.

If you happen to ask 'Where's the key to success?', the key to our success, not just mine — but others as well, is our ability to adapt to

changes in the economy, and the ability to treat people how they want to be treated, and service as a versatile product, not necessarily as service per-se.

How I Made The Decision To Update The Shop And Grow

It was based on nothing that I did or that I could take credit for; it was caused by conditions in the New England market. There was a tremendous

If asked 'where's the key to success', the key to our success, not just mine — everyone else's, is our ability to adapt to certain situations in the economy and the ability to treat people like they should be treated and to treat service as a versatile product... not necessarily as service. , ,

lack of quality service caused by the growth of the VCR, Camcorder, TV and CD markets, new products and changing technologies. When I became involved, dealers and customers were already crying out for service.

That's when I made the decision to expand. I said, 'this is a great opportunity to capitalize on this end of the business.' At that point, we started to invest in equipment, personnel and operations to get going. The economy and the conditions helped me make the decision—the American consumer caused the need for service, which caused me to go ahead and make the business prosper.

Are You Interested In Updating Your Equipment And Expanding Your Business?

Well, the first thing you have to do today, and this is not like yesterday — is do a study. You need to perform a 'market analysis' and understand who and what your customers are... and find out what your objective is, are they dealer orientated? Consumer orientated? Do you want to handle industrial or commercial accounts? What are your needs and where are you heading?



Fig. 2: If you are going to be a good and profitable shop, you are going to have to invest in quality equipment, that's the bottom line.

And then, most important, analyze and breakdown your business, your employees, and especially yourself, to understand one's capabilities. There are a lot of service companies out there, that have the potential for growth,

You May Have To Teach Your Techs Or Send Them To Special Schools

Our technicians attend countless seminars, because we service the Rhode Island,

“I think you need to talk of equipment and unfortunately it's not emphasized enough by the manufacturers and by everyone else, but if you are going to be a profitable shop, you are going to have to invest in quality equipment . . . that's the bottom line. ”

especially in today's market, that just don't know how to grow.

I think that before you're ready to invest in growing, you need to take a long look at a lot of different areas. Each case, each service company is an individual or family that is different. I believe you have to go in and analyze your requirements.

You Are Going To Have To Invest In Good Equipment, That's The Bottom Line

We can talk of something that is important to Sencore, and it's unfortunate that we lost some of the tax credits for equipment, but, in my opinion, you have to get down to equipment . . . and unfortunately it's not emphasized enough by the manufacturers and by everyone else, but if you are going to be a profitable shop, you are going to have to invest in quality equipment, I mean that's the bottom line . . .

After you have placed time and energy into structuring your business, your operations, and the right people, you still must have the right equipment. All my video people have the proper equipment at each bench. We spend, on the average \$5000 per bench, whether it be video, audio or cameras.

In our company, each product is a separate division; the people that work on Compact Disk players, are separate from the cameras and they are separate from those that work on VCRs and televisions, so everyone is a specialist. I'm a firm believer in two important things: education and equipment.

The products are changing so quickly, that if you can't change with the technology, you're not going to make it . . . the key is flexibility.

Because we're so large, we must do one of two things. It's very hard to keep up with technology when you're authorized by 50 different manufacturers, and it's becoming so costly to

“I'm a firm believer in two things first . . . education and equipment. ”

attend seminars . . . and most of the manufacturers do not provide sufficient ones. We have to either teach ourselves or have a manufacturer come in and teach at our location. Some manufacturers, because of our size, will do so. In cases where not, I have to send people to special schools, to learn what they need to know.

Freedom To Manage Helps Managers Achieve Goals

The way I personally run (our) business, is different from what other businesses do. I allow a lot of freedom to the individual associates that run their divisions or their service companies, to the individual managers within them, down to the supervisor who is running the television, VCR or audio departments.

They should be allowed their freedom to run their divisions, within certain parameters, of course. So, instead of commanding orders, that it must be done a certain way we'll form a meeting. I'll have certain monetary goals, philosophies, conditions and business that we need to accomplish. The managers themselves must try to achieve those goals.

Connecticut, New Hampshire, and Massachusetts markets. I would say there's probably a seminar each week among the different manufacturers that has to be attended.



Fig. 3: The products are changing so quickly, that if you can't change with the technology, you're not going to make it . . . the key is flexibility.

Develop Your Advertising For The Long Haul — Be Consistent And Professional

I'm a strong believer in marketing, and marketing whatever you do in life. We advocate advertising service, for instance we've advertised in the Boston Globe. We're one of the first companies to really advertise service as a product in this area, keeping within certain budget parameters. I think it's very important to point out various types of specialty services that you can provide your customer and the list of manufacturers that you service, the hours you're open and other concepts. It's a whole package.

It's very important that whatever logo you develop, whatever type of marketing strategy you follow, or how you set up your advertising, that over the long haul, it is consistent, and done professionally. It's just not something you stick in a little trade magazine and say 'Hi, I'm a service company and we have this type of service.' I don't believe, short term, is effective, but I think you need to sell, to market, and to advertise your product out there in a professional way and let people know, when they've bought a \$2000 camcorder, where they can receive quality service.

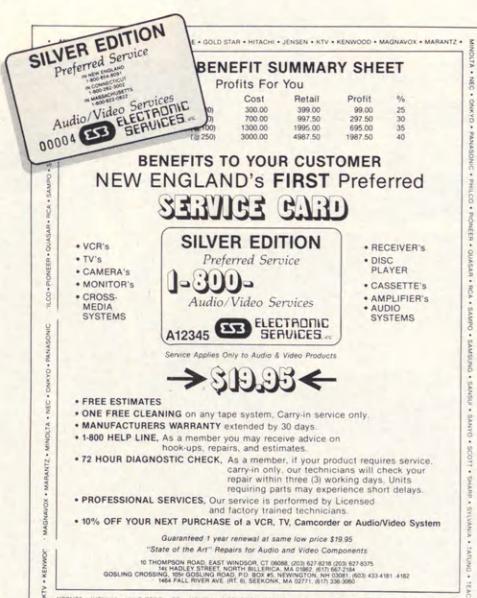


Fig. 4: You need to sell, to market, and to advertise your product out there in a professional way.

Should You Start Out With Cameras And Camcorder Service?

The camera department is probably one of the most expensive and intensive in terms of education and training. It's difficult to work on camcorders and cameras, and the different formats. It's very expensive, the test equipment and the accessory equipment that you need to repair cameras. We're one of the few companies in the New England area that is authorized for so many different cameras.

If You Can Justify The Need For Service, You Can Add The Test Equipment

I don't cost justify a piece of test equipment, I reverse the process. I determine the basic requirements for the bench, then before the test equipment is supplied, we'll sit down in a meeting, and I have to understand what people feel comfortable with . . . what manufacturers of test equipment do they like and what best suits their service needs? Again, I can't say to them, you will use a certain type of scope, or this type of equipment, I'll say, 'What feels good in your hands?' 'What have you trained on?' 'What type of support do we get?'

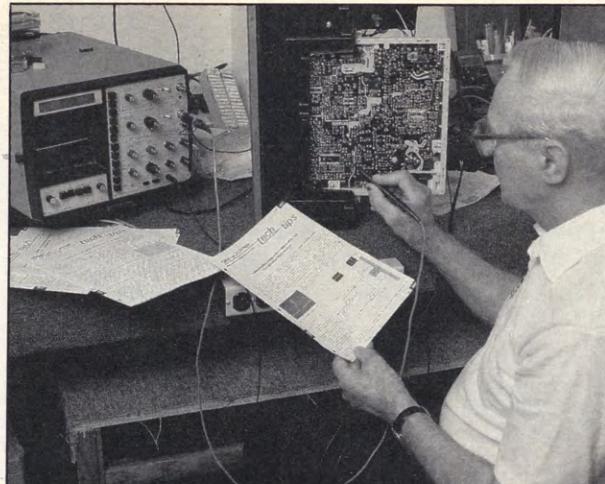


Fig. 5: Sencore test equipment and after the sale support is very important to our operation.

One thing about Sencore that's nice, is if test equipment is defective, we receive timely service. Just as when we service the consumer the turnaround time is important, and can we fix it?

“**N**o matter whether we pay a dollar, or we pay a thousand dollars, we like our products and we still want to have them serviced. ,”

We look at the whole picture, we don't just look at price; we look at what it does, how the technician uses it, and, of course, the warranty and service as well. Sencore test equipment and 'after the sale' support is very important to our operation.

Take Care Of Customer's Concerns Immediately

Everyone in the industry, by the nature of the beast, has recalls and customer

misunderstandings. Overall, we're running less than two percent. But, unless you have figures to compare, and can sit down and understand what the numbers really mean, a percentage doesn't help.

The basic thing we go back to, is when the customer has a problem . . . whether it be our fault, their fault, lack of understanding of the product, etc., the first thing we do is we spend time with the customer and explain what is wrong. If it is something that maybe we didn't fix properly, or goes into more of a technical aspect, then at that point we either call one of the managers, or if the technician is available we can pull him off of a job, to come to the front counter. The considerate thing that you have to do, is to take care of the customer's needs immediately and not just take the unit back and sit on it, or process it back into the system. It's very important that you get to that customer's concerns immediately . . .

A Word About Profit Opportunities

Talking about profit opportunities can be confusing, because you'll get into issues of manufacturers' warranties and warranty rates and what's fair and not fair. In a sense, there is no industry standard. However, in a retail sense, dealing with the consumer, if you ask "what's a more profitable line?", I think camcorders and VCRs are very profitable, another that is becoming more profitable today, is televisions! They have peaked again, because of the introduction of stereo television, plus the fact that more TVs are sold today than ever before. And, the new sets are selling. We've found some new additional profits in those areas. This year, I expect, because of the dollar to the yen ratio, the bottom end line of Japanese products will become more and more expensive; CDs will become very profitable to repair, also . . . not yet, but in the future.

It's A Tremendous Problem Servicing Projection And Big Screen TV—And It's A Tremendous Opportunity

That's a tremendous problem, one that the manufacturers are not able to deal with. Right



Fig. 6: Don't just take a unit back and sit on it, or process it into the system; it's very important that you get to the customer's concerns immediately.

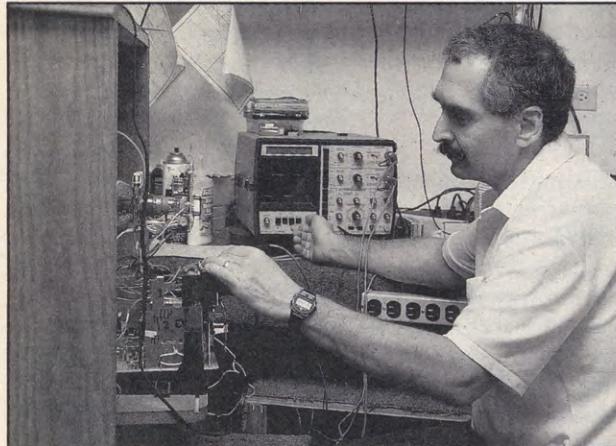


Fig. 7: As more people purchase large screen and projection TVs, consumers will have a tremendous problem getting service.

now, the reality is, because of higher costs and a slow down in the consumer electronics industry (although projection television percentage may be up) the manufacturers today are not dedicating, unfortunately, the training and support necessary to work in the field. We've spent a tremendous amount of money, and it is at a loss that we do projection TVs... to the consumer when you consider all the various types of insurances required. But it's part of the total service support system concept that we provide this service.

"I would say that in order to succeed... find out where your strengths and weaknesses are and capitalize on your strengths. Get back to the basics of how retail service was founded in this country and get back to servicing people and get back to the proper test equipment, the proper education, the proper way of doing business . . . , ,

And, as the sales increase and more and more people have purchased these products, it's going to become a tremendous problem in this country for service, because the cost of service in this area (New England) is just incredible. There are so many different factors involved that you don't normally have when you get into road service. You have different workmen's comp rules, different liabilities, different road expenses, different qualifications, and different licensing.



Fig. 8: The 35 inch single tube set weighs several hundred pounds and may require two or three people to work on.

There are many other things to deal with when you arrive at the consumer's house, things you have to be concerned with. In my opinion, the manufacturers have not yet realized their full responsibilities. There's so much test equipment that should be brought out that isn't being brought out. But, again, it's the cost factor, the support necessary to work. Let's not talk about projection TV for a moment, let's talk about the 35 inch single tube that weighs several hundred pounds, that maybe takes two or three people to work on. Let's talk about the qualifications, the expertise to do this work. It's so involved when you get to projection TVs and big screens.



Fig. 9: The more that consumer electronics becomes sophisticated and intertwined, the more service companies are going to have to update to accept the challenge.

The Industry, As We See It Today, Will Not Be The Same In Ten Years—Will You Accept The Challenge?

I'm sure that you've heard this before, but I either see big service companies becoming very large (and I don't know whether they'll survive when the manufacturers have such an unfair rate system), or you're going to see a bunch of very small specialty companies.

You'll be taking your product for service, not by category of manufacturer, but almost by

"One of the things we believe in, is the full service concept, and that's a concept of doing everything we possibly can for everybody. It's not tailored to one specific item, it's tailored to road service, in house service, hotels, motels, school systems, everything across the board . . . , ,

category of product definition. Maybe one shop that repairs camcorders can't repair VCRs, televisions, amplifiers or CDs or whatever. You're going to have the large service companies step into the 90's and become highly computerized and go on-line directly with manufacturers and have more direct support working with each other to solve this need for service. Either that, or we're going to have a collapse in the system.

I don't think the American consumer, as fickle as we are, will allow that to happen, because no matter whether we pay a dollar or we pay a thousand dollars, we like our products and we still want to have them serviced. Unfortunately, it's becoming very expensive, as so many other things are today. There's not a lot of good service companies anymore, especially not a lot of service companies that can do everything and that's becoming a problem for the consumer.

We Will Open Up More Service Companies And Expand Our Business

Sencore is always going to be our primary source of equipment, because Sencore supplies the VA62 and SC61. Those are the types of equipment we need; I won't go to anyone else; my loyalties have always been with Sencore and I'll stay that way. As we open up more service companies and as we expand into more divisions, I see Sencore as a major part of what we do.

If You Want To Succeed In Electronic Service

In order to succeed, or if you wish to succeed, you're going to need the cooperation of your business community, the cooperation of some type of warranty legislation, and the cooperation of the manufacturers. My advice to anyone that is in electronics service is: you're going to have to re-define your industry, find out where your strengths and your weaknesses are, capitalize on your strengths and understand your weaknesses. Get back to the basics on how retail service was founded in this country, to servicing people and get back to the proper test equipment, education, and way of doing business.

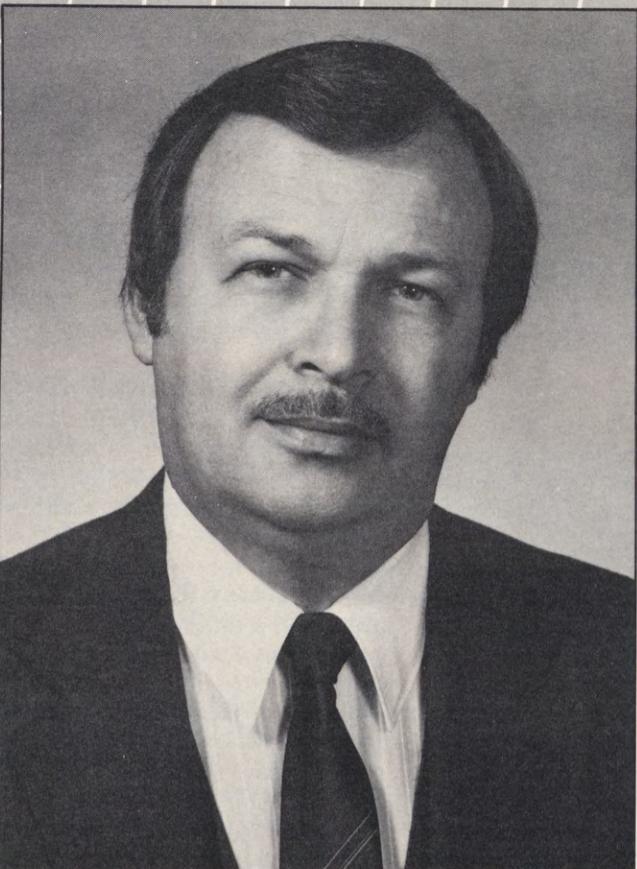


Fig. 10: As we open up more service companies and as we expand into more divisions, I see Sencore as a major part of what we do.

You're going to see a lot of changes... the more that consumer electronics becomes sophisticated and technology changes, the more products we have in our homes, and the more that they intertwine to one another, service companies in this country are going to have to come up a few notches to update and accept the challenge.

I see a lot of changes for future servicers; I see the industry as we see it today, not the same in ten years; there's going to be a lot of new and different things happening. Where will you be in your service operation then?

One of the things we believe in, is the full service concept, and that's a concept of doing everything we possibly can for everyone. It's not tailored to one specific item, it's tailored to road service, in house service, hotels, motels, school systems — everything across the board.



EIA Responds To Technicians' Cries For Help

by Don Hatton, Staff Vice President, Product Services
Consumer Electronics Group

The Electronic Industries Association (EIA) was founded in 1924 and is the only national trade association representing all segments of electronics manufacturing. The EIA is strategically located in the nation's capital and is a recognized vehicle for the cooperation of industry executives in addressing their common concerns. The Product Services Committee (PSC) of the EIA's Consumer Electronics Group has been dedicated to the advancement of training and support of the consumer electronics service industry.

The Safety and Engineering Subcommittee of the Product Services Committee, under the direction of Subcommittee Chairman John Newman (Toshiba) was assigned the task of evaluating the test equipment required to service the wide array of consumer electronic products. The subcommittee brought together servicers, test equipment manufacturers and manufacturers, and have developed a list of recommended test equipment for the consumer electronics technician.

This list of recommended test equipment takes into account not only the products currently in the marketplace, but also products that are expected to arrive on the market in the very near future. The Product Services Committee is currently analyzing the needs for other products such as cellular phones, auto radios, and telephones to include regular, cordless and cellular.

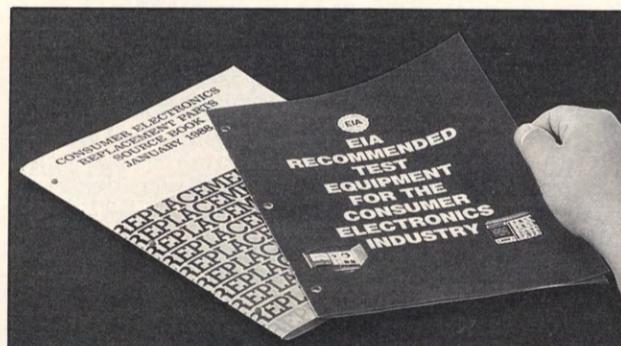
Many manufacturers currently rely on EIA's Recommended Test Equipment list when evaluating a service operation for authorization.

EIA's Product Services Committee is involved in other service functions such as developing "electronic warranty claims filing" standards and the standardization of "failure/repair" codes. Servicers will also find a number of video training tapes that have been produced by the EIA in conjunction with the service entities of its members. Copies of EIA's Recommended Test Equipment booklet is available free of charge by writing to Electronic Industries Association, Consumer Electronics Group, P. O. Box 19100, Washington, DC 20006. ■



"Probably the most important criteria is the training of the technicians and their use of proper test equipment . . ."

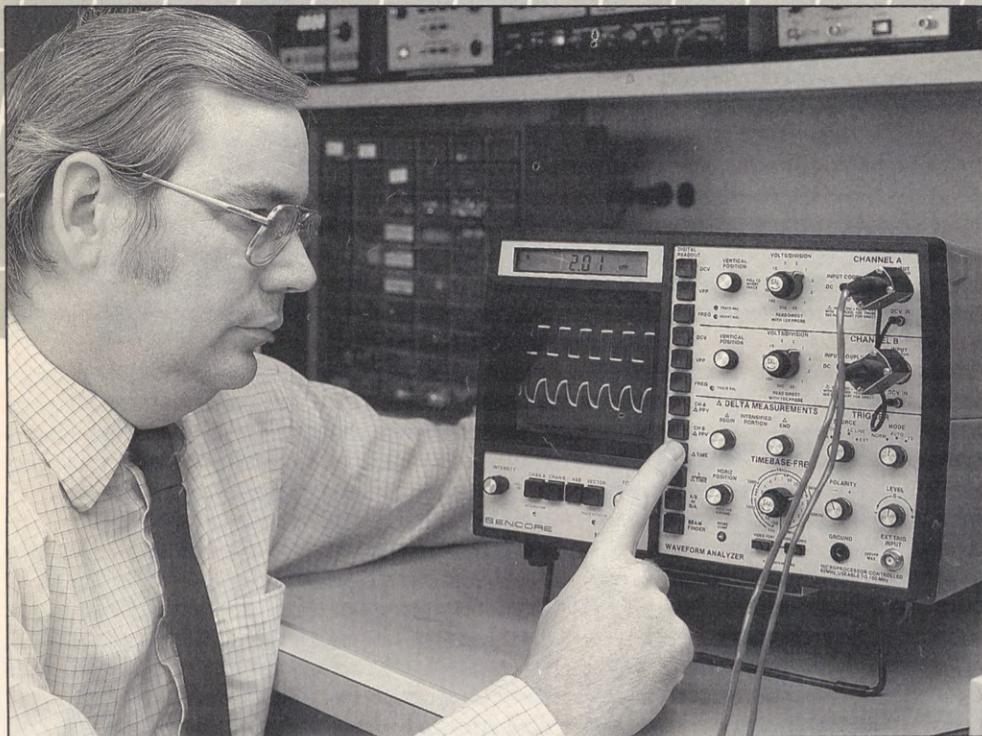
The consumer electronics industry swept into the decade of the eighties on a technological tidal wave that brought with it a new generation of entertainment, educational and commercial products in systems that already had a profound impact in the lifestyles of America. No other industry in our country's history has seen growth as explosive as that of the electronics industry. But, even the best of these products sometimes require maintenance. The more sophisticated these products become, the more



sophisticated the servicing techniques will become. Manufacturers have a perpetual concern that in the event their products need servicing, fast and efficient service must be available. To assure quality servicing to the consumer, manufacturers will "authorize" service facilities providing they meet stringent manufacturer guidelines.

Probably the most important criteria is the training of the technicians and their use of proper test equipment that will allow quick and efficient servicing of the manufacturer's products. To assure that the proper test equipment is available, manufacturers would specify the exact equipment required to qualify as an authorized servicer. Unfortunately, not all manufacturers specified the same equipment. Therefore, service facilities have been required to purchase several different brands or models of test equipment, that in many cases, did the same job. In the early part of 1987, servicers finally turned to the Product Services Committee of EIA to assist with this problem.





You Can Analyze Any Waveform Ten Times Faster, With Zero Chances Of Error With Your SC61 Waveform Analyzer™

by Rick Meyer, Application Engineer

A pure sinewave can be easily analyzed using digital meters. The amplitude can be measured with a peak-to-peak voltmeter. The frequency can be measured with a frequency counter. The average DC voltage level can be measured with a DC voltmeter.

Most signals encountered in electronics are not as simple as a sinewave. The most common signal, other than a sinewave, is a squarewave. With the expanded use of digital technology, the squarewave has become very common and can be found in almost all consumer electronics equipment.

Ideally, a squarewave is simply a voltage that alternates between two levels. In digital circuits,

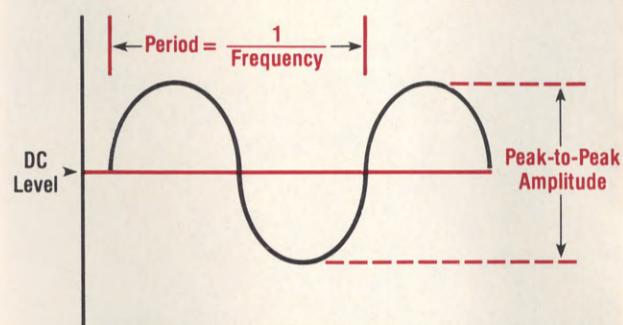


Fig. 1: A pure sinewave can be analyzed by measuring its peak-to-peak amplitude, frequency and DC level.

“ Time savings is the most important consideration when analyzing waveforms — the ability to service successfully in less time, puts extra money in your bank. . . ”

Electronic circuits found in radios, TVs, VCRs, etc., are used to generate signals or amplify, filter, and modify external signals that are fed to them. These signals take the form of sinewaves, squarewaves, sawtooth waves, and more complex waveforms.

For example, you will see sinewave signals in bias oscillators in tape recorders. Squarewaves are found in the many digital control circuits used in modern audio equipment. More complex waveforms are seen when music is played through an audio circuit.

In video, sinewave signals are found in oscillators, such as the 3.58 MHz color oscillator. Squarewave signals are found in the digital control circuits and in the new digital TVs. Sawtooth waveforms are found in vertical deflection circuits. Complex waveforms are found in the circuits that process the composite video signal.

Time savings is the most important consideration when analyzing complex waveforms, because the ability to service successfully (in less time) is what puts extra money in the bank.

In many cases, complete analysis of a signal requires you to view the waveform on a CRT as well as measure it with a meter. With your SC61 Waveform Analyzer, you have both capabilities. A CRT to visually check for distortion in the waveform as well as digital measuring capabilities to analyze the waveform for its key characteristics.

All waveforms have characteristics which can be used to define whether they are good or bad for the circuit you are troubleshooting. In order to understand what to look for when analyzing a waveform, you must first understand basic waveform characteristics.

Understanding Basic Waveforms Helps You Understand Complex Ones

The simplest waveform is the sinewave (Figure 1). There are three important characteristics of this waveform:

1. Peak-to-peak amplitude
2. Frequency
3. Average DC level

one level corresponds to a “1” and the other level corresponds to a “0”. Like a sinewave, a squarewave has three important characteristics:

1. Peak-to-peak amplitude
2. Frequency
3. Average DC level.

On the surface, a squarewave looks quite simple; the voltage is either high or low. In reality, it is much more complex. In an ideal squarewave, the voltage switches levels instantaneously. This instantaneous change in level requires infinitely high frequency signals. In practice this is not possible. The capacitances, inductances, and resistances in the circuit limit how fast the voltage level can change.

A squarewave normally is considered as a signal

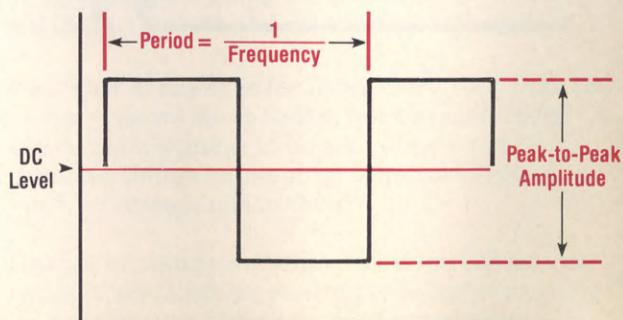


Fig. 2: The square wave is deceptively simple. In reality it is a complex waveform made up of an infinite number of high frequencies.

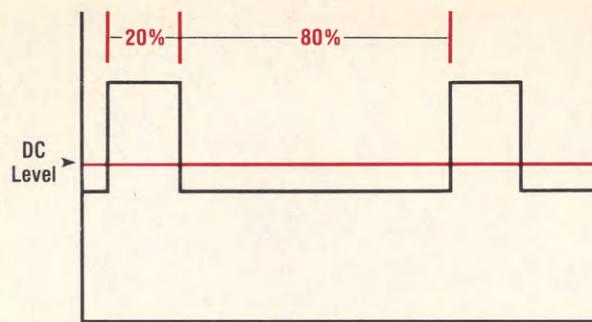


Fig. 3: To analyze a pulse waveform, you must measure its on and off time (duty cycle) as well as DC level and peak-to-peak amplitude.

that remains in the high state 1/2 the time and then goes back to the low state. A pulse is a special case of a squarewave. The main difference between a pulse and a squarewave is in the amount of time at which the pulse stays at a high or low state. The amount of time the signal stays at one level is called the duty cycle. For instance, a signal that has a duty cycle of 20% is in one state for 20% of the time and is in the other state for the remaining 80% of the time.

In addition to the sinewave, squarewave, and the pulse, other more complex waveforms are often encountered in servicing. For example, the vertical circuits in a television often use a sawtooth, or modified sawtooth signal to drive the deflection circuits. Another complex waveform is the composite video signal (Figure 4). This signal consists of squarewaves, sinewaves and combinations of these and other waveforms.

Using a conventional scope, simple waveform measurements require 10 steps plus a mental calculation. (See example below.)

With the SC61 Waveform Analyzer, you can make this measurement in 1/10th the time.

Actually, the measurement below can be made in one second using only one step. Simply press the VPP button of the channel the signal is on and read the display. You don't even have to look at the signal. The main use of the CRT on the SC61 is to visually check the shape of the waveform.

Measure Pulse Widths Fast With The SC61 Delta Functions

Let's look at another signal, the flyback pulse on the collector of the horizontal output transistor of

a television. This signal is classified as a pulse even though it does not have square edges like a digital pulse. Again, we can analyze this pulse by observing it on the CRT as well as checking its important characteristics with the SC61's digital meter. In 3 seconds you can measure the peak-to-peak amplitude of the pulse, check its frequency, and measure the DC voltage of the collector of the horizontal output transistor.

This signal has two additional characteristics that you need to check. First, use the CRT to check the waveshape of the pulse. Be sure that it does not have deep saddles in it, which could indicate circuit problems. This cannot be measured with a meter. It must be viewed on the CRT.

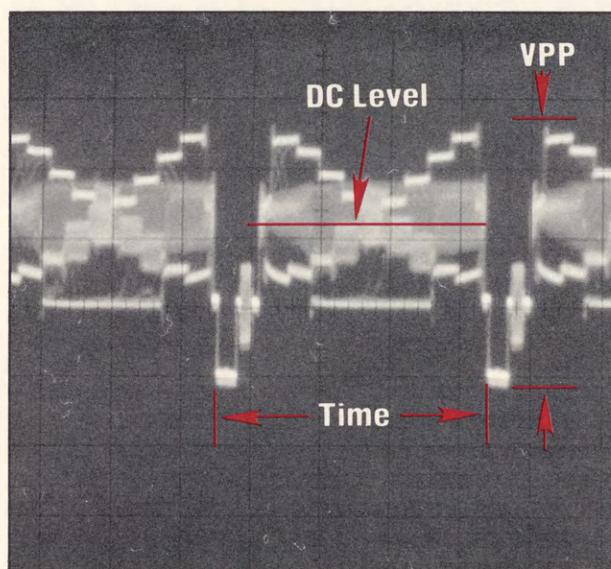


Fig. 4: Of all the waveforms you'll analyze in consumer electronics service, the composite video waveform is the most complex. It includes squarewaves, sinewaves, pulse and other waveforms.

Second, measure the duty cycle of the pulse. This is important in this circuit since too wide or too narrow a pulse also indicates a circuit problem. Your SC61 Waveform Analyzer's delta features allow you to check any portion of a waveform with digital accuracy. Press the DELTA TIME button; notice that part of the CRT trace is brighter than the rest. The bright portion of the trace is being measured by the digital meter. By using the DELTA BEGIN and DELTA END controls, you intensify just the pulse portion of the waveform. You then read the time the pulse is on. This is displayed on the SC61's digital meter.

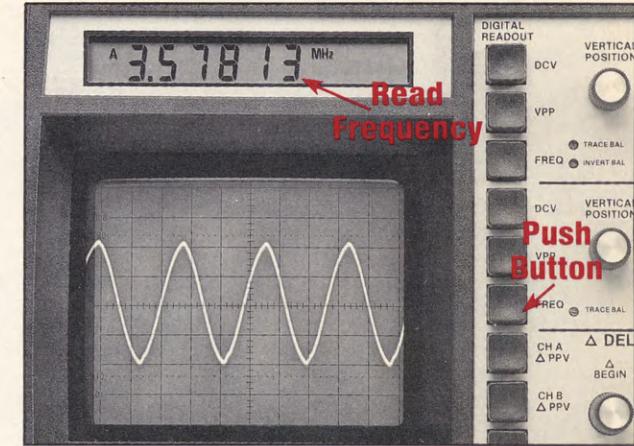


Fig. 5: Measuring frequency is as simple as pressing a button — you can completely analyze this signal in only 3 steps with your SC61.

The SC61's Digital Features Along With The CRT Speeds Your Troubleshooting

Understanding, measuring, and interpreting waveforms is an everyday part of electronic servicing. Your business success could depend upon how confident you are at analyzing waveforms.

As owners testify, the speed of measuring waveforms quickly pays for your SC61. Not only does the CRT of the SC61 Waveform Analyzer let you view the waveform and look for distortion, but the digital meter gives you fast digitally accurate readings of all waveform parameters. To update your service operation to an SC61 Waveform Analyzer, call 1-800-843-3338 and ask for your Area Sales Engineer.

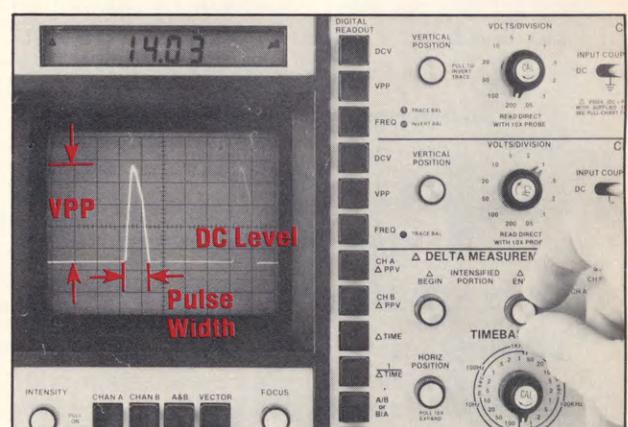


Fig. 6: With your SC61 Waveform Analyzer you can completely analyze this pulse in 3 seconds or less!

Conventional Scopes Waste Time And Require You To Calculate Results

An oscilloscope is important in waveform analysis. It lets you look at the waveform to determine if it is the correct shape. In conventional oscilloscopes, measurement of the key waveform parameters is done from the CRT. For example, let's look at a 3.58 MHz color oscillator signal in a television. Two characteristics are important in this waveform; the peak-to-peak amplitude and the frequency.

On a conventional scope, the peak-to-peak amplitude is simpler to measure than the frequency. Let's start with this measurement. Assume that you already have the signal source connected up to the oscilloscope.

The following steps must be made:

You must first adjust the triggering to obtain a waveform on the CRT. This involves at least 3 steps.

1. Set the trigger source to the channel the signal is applied to.
2. Set the trigger mode to the AUTO position.
3. Adjust the trigger level to obtain a trace.

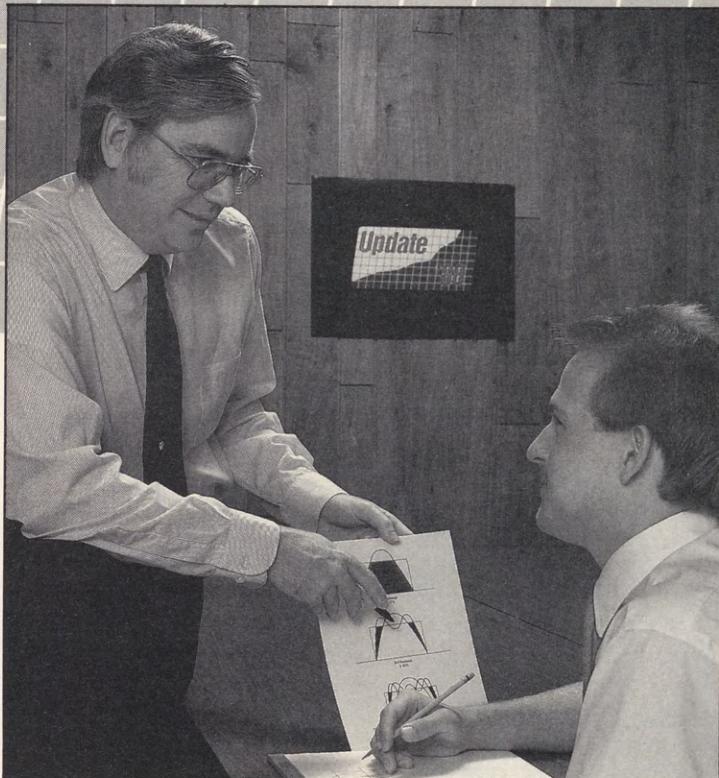
If no trace is found, the signal may be too small or the timebase setting may be incorrect. Two more adjustments will be needed.

4. Increase the sensitivity of the vertical input of the oscilloscope until a trace is seen.
5. Adjust the timebase so that a sinewave signal is seen.

You are now ready to make your measurement. This requires 5 more steps.

6. Set the vertical position control so the bottom of the waveform is on a major horizontal graticule line.
7. Adjust the horizontal position control so that the peak of the waveform is centered on the center of the CRT.
8. Count the graticules. In this case it is 3.6 divisions.
9. Check the setting of the vertical attenuator. In this case, it is 2 volts/division.
10. Multiply the vertical attenuator setting by the number of divisions counted in step 8. In this case the answer is 7.2 VPP.

With the SC61 Waveform Analyzer, you can cut this measurement to one step!



Tech Talk

Understanding The Effects Of Oscilloscope Bandwidth

by Rick Meyer, Application Engineer

Understanding Squarewaves, Why They Are A Challenge And Where They Are Used

A sinewave signal is relatively easy to display on an oscilloscope. A 15 MHz oscilloscope will display a 15 MHz sinewave with little or no distortion. The only difference is that the amplitude will be reduced by 3 dB. A squarewave is another matter. Squarewave signals have frequency components that extend out well beyond the fundamental frequency of the squarewave. Ideally, harmonics of the squarewave's fundamental frequency extend out to infinity. From a practical standpoint, this never happens. Thus, we can view a squarewave with an oscilloscope that has an upper frequency limit (See Table 1).

TABLE 1

Signal	Percent Contribution
Fundamental	81.17%
3rd Harmonic	9.02%
5th Harmonic	3.24%
7th Harmonic	1.65%
9th Harmonic	1.00%
11th Harmonic	0.67%
"	"
etc.	"
Infinity	Zero

Each succeeding harmonic contributes less and less to the formation of the squarewave.

“ In addition to its speed, accuracy and ease of use, your SC61 Waveform Analyzer’s bandwidth is ideal for consumer electronics service . . . ”

A question often asked when considering the purchase of a new oscilloscope is “How much bandwidth do I need?” You might be surprised to learn that the difference in readings of a 60 MHz and a 100 MHz oscilloscope is often less than the accuracy of reading the CRT. In fact, in addition to its speed, accuracy and ease of use, your SC61 Waveform Analyzer’s bandwidth is ideal for consumer electronics service. To understand why this is so, let’s look at the effect bandwidth has on a typical signal.

The topic of bandwidth in scopes is often confusing. Bandwidth defines the frequency range at which a sinewave signal is reduced 3 dB in amplitude. This is generally given as one figure: 30 MHz, 60 MHz, 100 MHz, etc. The bandwidth specification, however, does not give a complete picture of how a scope will perform on the signals you need to analyze.

The frequency response beyond the 3 dB point is just as important as the bandwidth. That is, the rate at which the response rolls off can be more important than the 3 dB point. Generally, a slow Gaussian roll-off is desired (Figure 1).

The bandwidth of an oscilloscope can be increased by modifying the roll-off characteristics beyond the 3 dB point. Peaking circuits are often used to extend the higher limit of the 3 dB bandwidth. This has an affect, however, on the rate of roll-off. This is of little importance if you are working on sinewave signals, but it is very important for complex waveforms which need the response out beyond the 3 dB point.

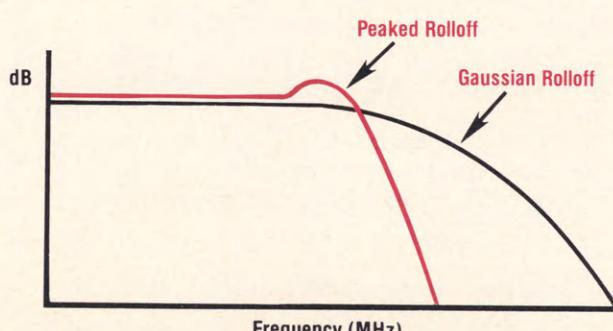


Fig. 1: Your SC61's smooth Gaussian roll-off ensures that complex waveforms are displayed nearly equal to scopes that have bandwidths to 200 MHz.

Squarewave signals are most often encountered in digital circuits. The highest frequencies are generally the clock signals. Most clock signals in consumer electronics operate in the 2 to 5 MHz range. Some clocks, such as those in some personal computers, operate as high as 10 to 15 MHz. Our research indicates that over 99% of all digital circuits operate at a frequency of 15 MHz or less. The number of high frequency squarewave signals is quite small in relation to low frequency squarewave signals. Thus, 15 MHz is the highest squarewave you will likely encounter in consumer electronics service.

Understanding The Squarewave Helps Understand Oscilloscope Bandwidths

In order to understand the bandwidth needed to view a squarewave signal, you need to know what frequencies make up this signal. A squarewave is composed of a fundamental sinewave frequency and an infinite number of harmonics. A squarewave can be mathematically represented by the Fourier series;

$$F(t) = A \sin(\omega t) - A/3 \sin(3\omega t) + A/5 \sin(5\omega t) - A/7 \sin(7\omega t) + \dots A/N \sin(N\omega t)$$

Where A is the fundamental amplitude and (wt) is the fundamental frequency. This formula says

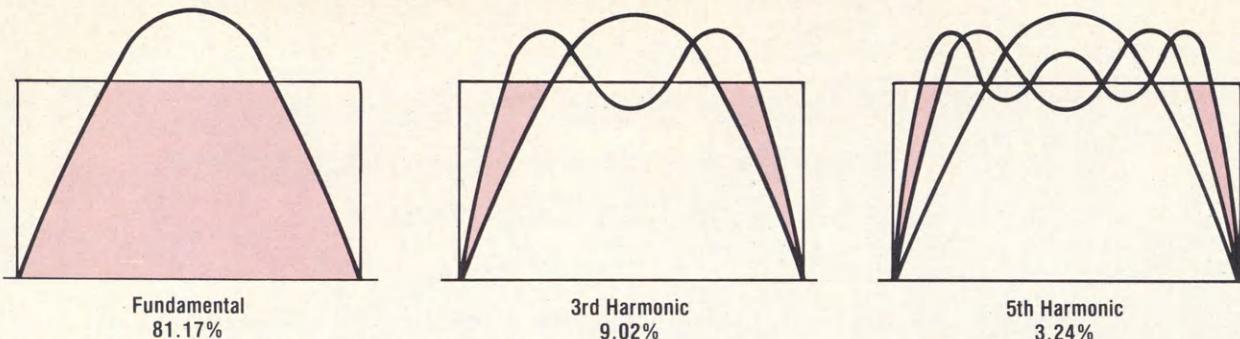


Fig. 2: The fundamental contributes the most to the formation of a squarewave. Each succeeding harmonic contributes less.

that a squarewave is composed of a fundamental sinewave signal plus sinewaves at 3 times, 5 times, 7 times and so forth, of the fundamental frequency. The higher order sinewave signals are the harmonics. The harmonics become increasingly smaller in amplitude the higher in frequency they are. The 3rd harmonic is 1/3 the amplitude of the fundamental, the 5th harmonic is 1/5 the amplitude of the fundamental, and so forth.

Each harmonic contributes less and less to the formation of the squarewave. The fundamental contributes the most; each succeeding harmonic contributes less (Table 1).

How Frequency Response Affects Measurement Accuracy

As Figures 2 and 3 show, the higher order harmonics make up the sharp rising and falling edges of the squarewave. The contribution of each higher order harmonic decreases as the frequency increases. Thus we rapidly come to a point where the harmonics contribute relatively little to the shape of the squarewave. As Table 1 shows, 94% of the shape of a squarewave is due to the fundamental frequency, the 3rd, and 5th harmonic.

So what does this have to do with the bandwidth of an oscilloscope? Let's look at a 12 MHz signal using a 60 MHz, 100 MHz, and 200 MHz bandwidth oscilloscope (Figure 4). Can you tell which one is which?

Notice that little change is observed in the CRT display of the squarewave from one oscilloscope to another. Why can your SC61 display a 12 MHz squarewave almost as good as a 200 MHz scope? To understand why, let's look at the effect the bandwidth of an oscilloscope has on the harmonics. We'll compare a 60 MHz bandwidth versus a 100 MHz bandwidth, and assume a gentle Gaussian roll-off in both cases.

We first need to look at the effect the oscilloscope has at higher frequencies. To simplify calculations we will look at a 12 MHz squarewave

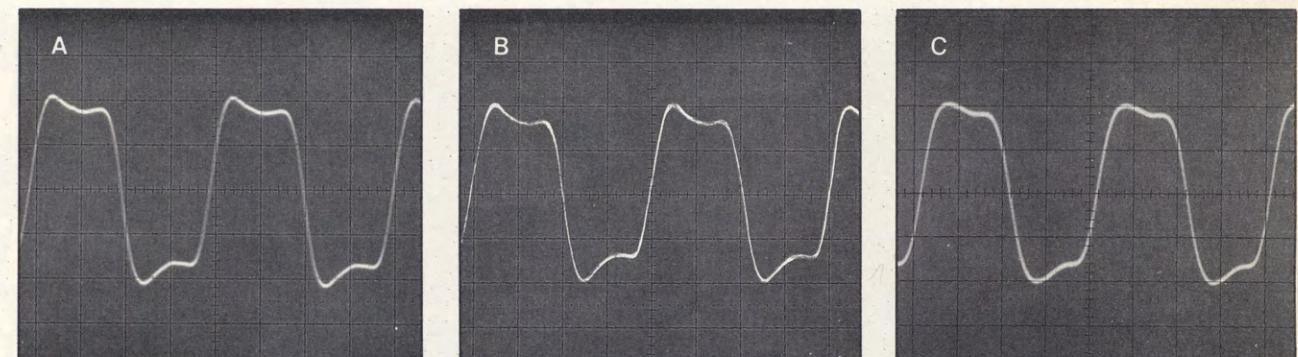


Fig. 4: The same 12 MHz squarewave signal is displayed, above, on a 60 MHz, 100 MHz, and 200 MHz scope. Can you tell which one is which? (Answer is at the end of this article.)

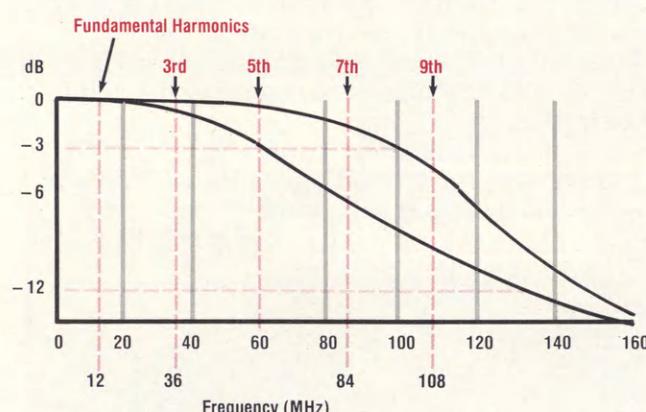


Fig. 5: The higher harmonics contribute less; therefore errors induced by rolloff account for only 2.5% of the total makeup of a 12 MHz squarewave.

signal (Figure 5). The harmonics are located at 36, 60, 84, 108 MHz, etc. For the 60 MHz response curve, the signal level is unaffected for the fundamental, and the 3rd harmonic. The 5th harmonic is down 3 dB. In other words, the 5th harmonic signal is approximately 70% of the normal value. At 84 MHz the 7th harmonic signal is down approximately 6 dB or 50% of the normal value. At 108 MHz the 9th harmonic signal is down approximately 12 dB and is 25% of the normal value. For the 100 MHz oscilloscope, the levels drop only a few percent at the 9th harmonic.

Now, let's look at the affect this difference in bandwidth has on the signal. Figure 6 shows the amplitudes of the fundamental, 3rd, 5th, 7th, and 9th harmonics. The red portion of the 5th, 7th, and 9th harmonic show the error in the amplitude induced by the roll-off of the 60 MHz bandwidth. When these errors are added up, they account for only 2.5% of the total makeup of the squarewave. This error is less than the interpretation error in reading the CRT.

The ability of a CRT to display a waveform is limited by the introduction of two fundamental errors: the accuracy of the vertical deflection amplifiers, and the servicers' ability to visually read the display.

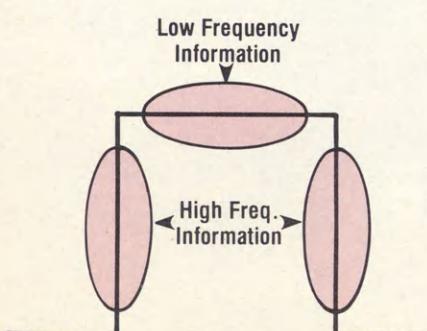


Fig. 3: The higher order harmonics make up the sharp rising and falling edges of a squarewave.

Typical accuracy of an oscilloscope vertical deflection amplifier is 2%. Thus, any signal fed into a deflection amplifier is correct to within 2% of the true value.

A greater error is introduced by the inability to accurately view and analyze the waveform. The waveform displayed on a CRT is actually the glowing of the phosphors in the CRT, when hit by an electron beam. The trace has a finite width.

Typically, we view a waveform over half the screen. Since most CRTs have 10 major divisions on the CRT face, a typical waveform will cover 5 major divisions. Each major division is further divided up into 5 smaller divisions. The CRT trace on an oscilloscope is typically as wide as one

of these smaller scale divisions. Thus, the width of the trace takes up 0.2 divisions. 0.2 divisions divided by 5 divisions equals 4% or more of the area of the waveform.

Our ability to accurately read the CRT is limited by the combination of the 4% error due to the width of the CRT trace and the 2% error in the vertical deflection amplifiers. Thus, a minimum of a 6% error exists in trying to read a waveform from the CRT. When we compare this 6% reading error to the 2.5% error created by a CRT bandwidth limitation, we see that the bandwidth limitation is not significant.

For this reason, your SC61 Waveform Analyzer provides digitally accurate peak-to-peak voltage and frequency measurements that take these interpretation errors out. The SC61's digital meter measures the selected channel's signal *before* the vertical deflection amplifiers, thereby eliminating the 2% error introduced by these amplifiers. In addition, readings do not have to be taken off the CRT so the 4% or more reading error is also eliminated. Thus, measurements to 100 MHz are enhanced with the SC61's digital meter.

As you can see, increased CRT bandwidth is a secondary consideration over the digital accuracy and ease of use of the SC61 Waveform Analyzer. To try the SC61 on your bench, call 1-800-843-3338 and ask for your Area Sales Engineer.



Answer to Fig. 4: (A) 100 MHz (B) 200 MHz (C) 60 MHz

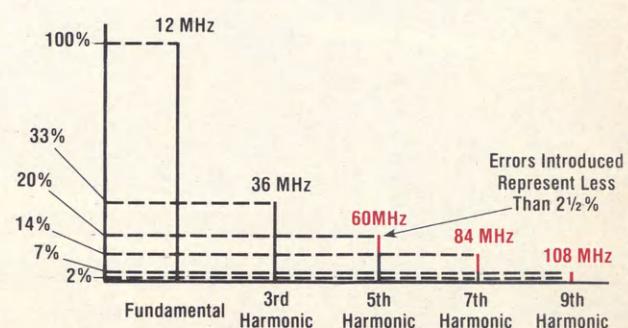
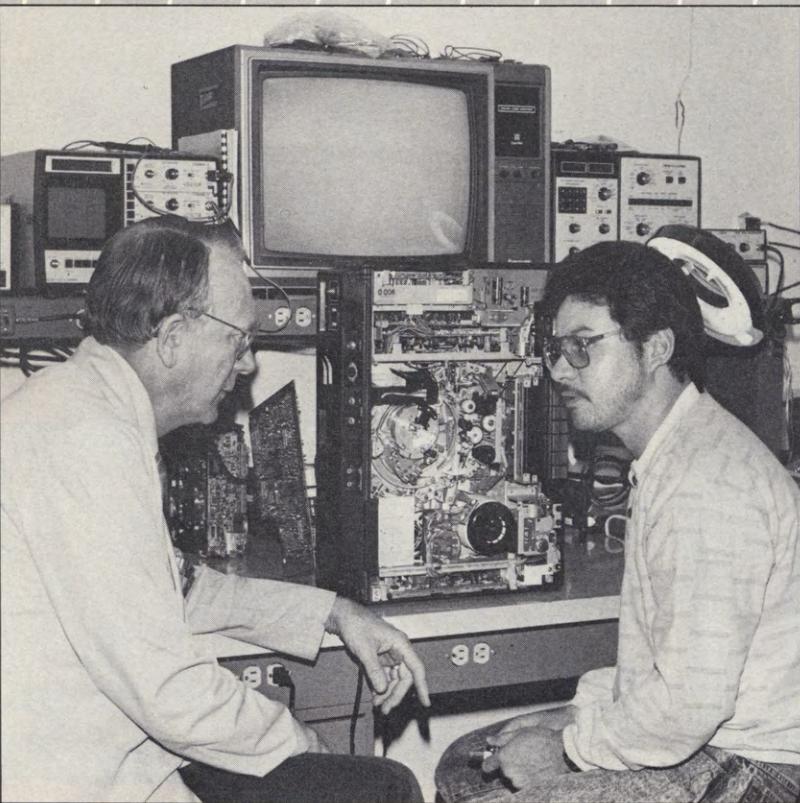


Fig. 6: The higher harmonics contribute less; therefore errors induced by rolloff account for only 2.5% of the total makeup of a 12 MHz squarewave.



Harry Sanders

Angel Rivera

Harry Sanders, Instructor in the Consumer Electronics Technician Program at Clover Park Vocational Institute in Tacoma, WA, praises Sencore equipment because of its "accuracy, ruggedness and dependability in the classroom."

"As far as I'm concerned," adds Harry, "there is no better equipment of its kind."

"We've never even had a knob break off, even though the students give the equipment extremely hard wear and, in a sense, an abnormal amount of usage."

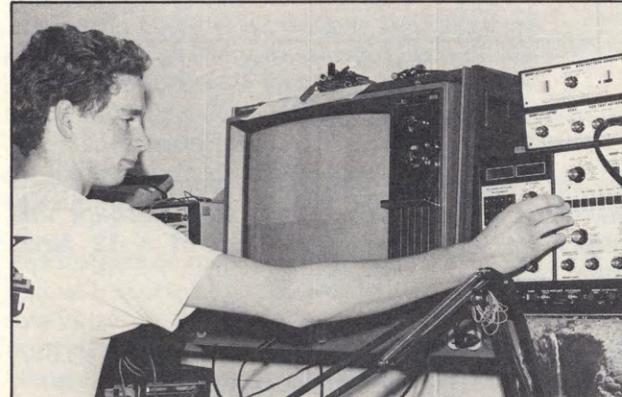


Fig. 1: Gunter Monroe likes the Sencore equipment because "it speeds up troubleshooting."

In the 11 years he's used Sencore equipment in his training program, Harry has never had to "cannibalize" a single piece of equipment or replace it because of obsolescence.

"We've never even had a knob break off, even though the students give the equipment extremely hard wear and, in a sense, an abnormal amount of usage."

Harry also likes the fact that Sencore's "1-800" number is available to students and instructors, should questions regarding the equipment or its use arise.

"We also have an excellent business relationship with Sencore," said Harry, whose video cassette recorder laboratory is equipped nearly exclusively with state-of-the-art Sencore products, including four complete workbenches. Equipment available at the workbenches includes the SC61 Waveform Analyzer, VA62 Universal Video Analyzer and a PR57 "POWERITE"® for each of the four benches. Other Sencore

Sencore Gives You Accuracy, Ruggedness And Dependability; Ideal For The Classroom

by Judy Davis, Vocational Information Specialist,
Clover Park VTI

equipment available to all students includes the LC53 Z Meter, TF46 Crickets, VA48 Video Analyzer and SG165 AM/FM Stereo Analyzer."

Available primarily to low income and elderly customers, the VCR lab is part of the "realistic training" offered by the Clover Park VTI. It functions much like an outside shop, with students responsible for customer contact, actual repair work and record keeping, under the supervision of Sanders who had more than 30 years of experience in the electronic repair field prior to joining the VTI staff in 1977.

Angel Rivera, shown with Mr. Sanders (above left), is one of the select students working in the VCR lab; he appreciates the equipment available, since he feels it is "way ahead of that offered in a lot of training programs."

Graduates of Sanders' two-year program repair all types of home electronic equipment, including radios, television sets, tape recorders and stereo units. For the first year of their training, students learn basic electronics, and troubleshooting skills from David Quails; Sanders teaches advanced troubleshooting techniques for a variety of consumer products as well as shop management.

Besides finding employment in consumer electronics, graduates of Quails' and Sanders' program also find jobs in closely related industries such as computer maintenance, photocopiers, medical instrument maintenance, CATV companies and closed circuit security systems, Sanders explained.

"With our students," he added, "having skills that are transferable is often a key to success."

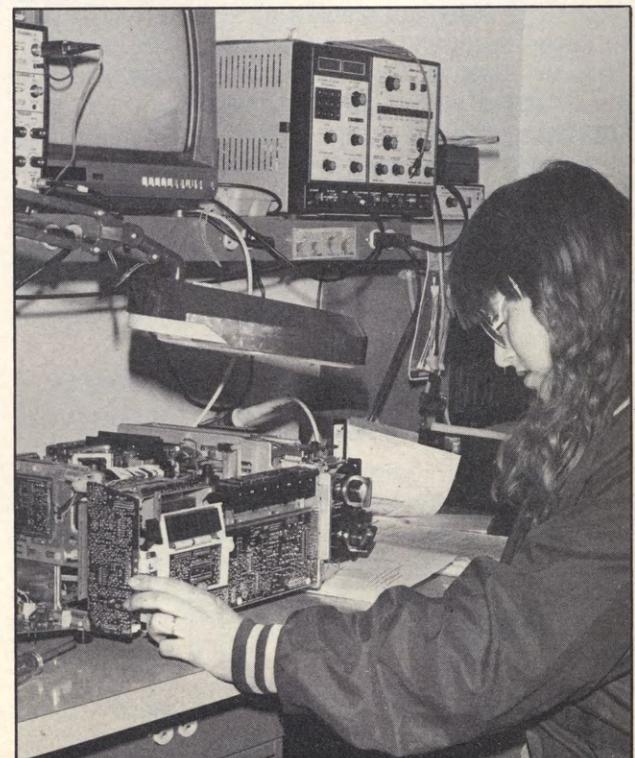


Fig. 2: Kathy Goodrow finds Sencore equipment "easy to use."

Update

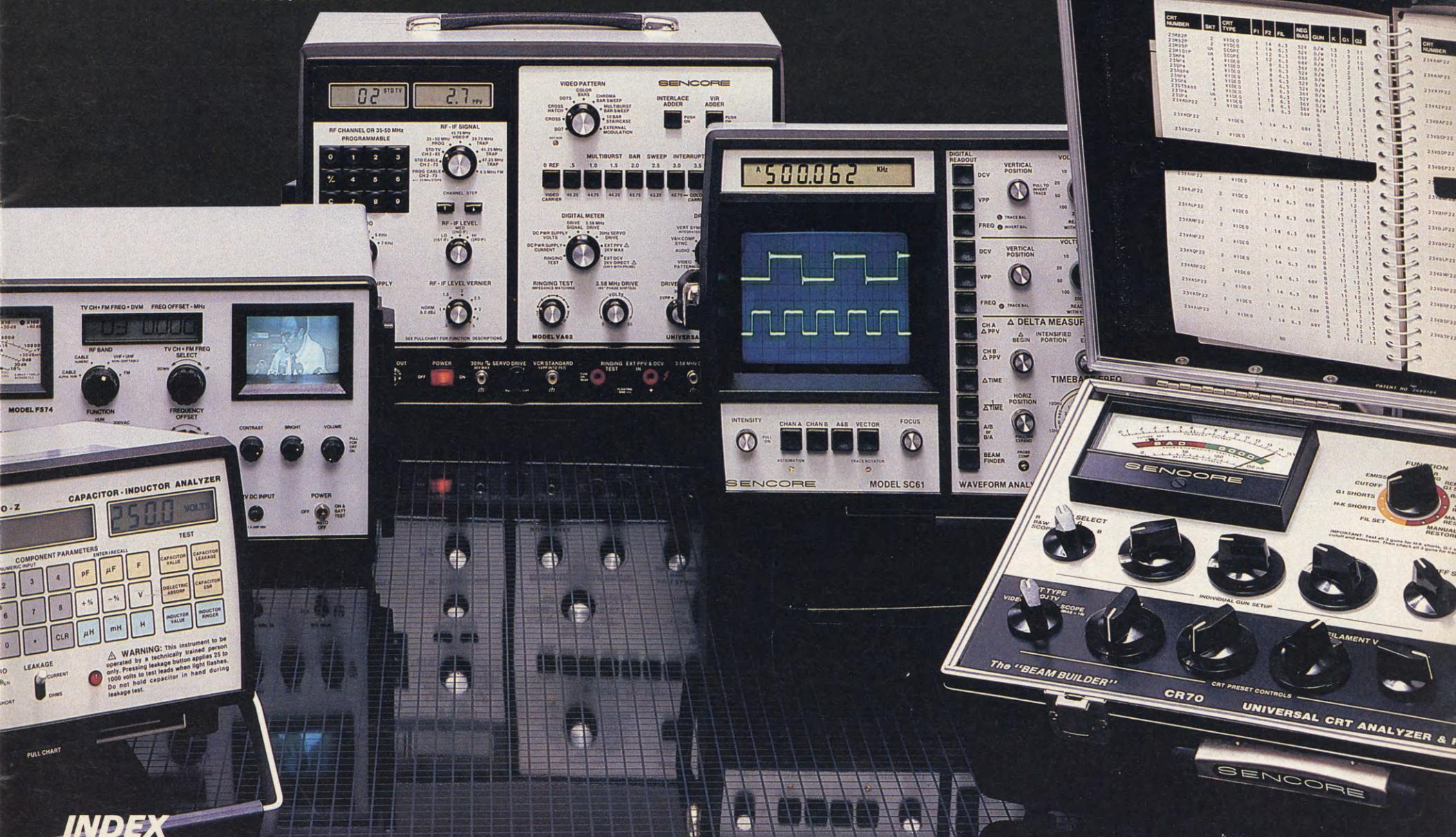
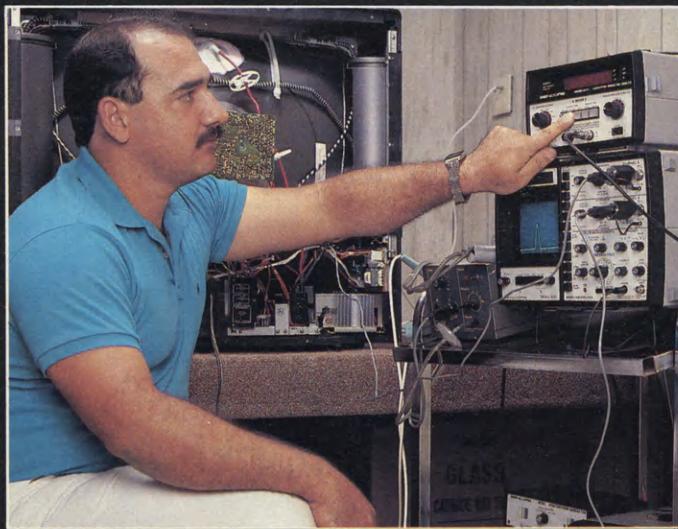
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Discover the Z Standard that eliminates the guesswork, interpretation and calculation errors in capacitor and inductor testing. The LC77 AUTO-Z makes testing any capacitor or coil simple, without having to make calculations or pull out look-up charts to determine if the component is within standards. Its advanced digital technology completely analyzes capacitors and inductors for all the ways they can fail. You simply enter the parameters: value with the tolerance you require, the rated voltage of the device and the type of device. The LC77 AUTO-Z takes over from there and compares the actual readings to standards tables stored in its memory, and simply displays if that component is good or bad based on EIA and industry standards. It's like having a Standards Engineer with you all the time.

Thoroughly and automatically analyze any capacitor from 1 pF to a massive 20 farads. Only the LC77 AUTO-Z allows you to test today's high tech components. The AUTO-Z tests capacitors for every parameter in which a capacitor can fail. It reads out the capacitor's value and whether it's good or bad based on the tolerances that you want. Plus the LC77 gives tests no one else gives you. Tests for leakage, dielectric absorption and ESR, and it tells you if the cap is good or bad based on EIA and industry standards.

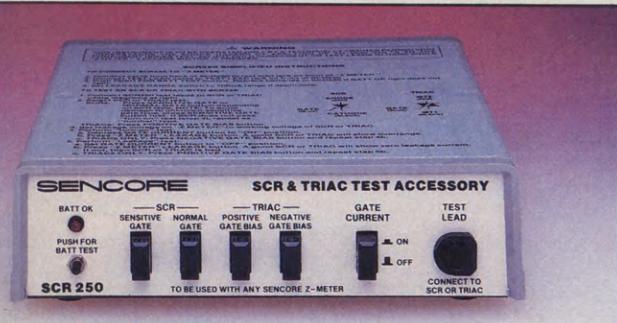
Finally, test inductors reliably from .1 uH to 20 henrys. The LC77 AUTO-Z tests inductors dynamically so you have a way to finally track down tough-to-find coil problems. The LC77 automatically reads out the inductor's value, and if it is good or bad based on your tolerances. It also gives you an automatic ringing test

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Locate capacitor and inductor failures that all other testers can't find. Measure capacitors from 1pF to 200,000 uF and test them at voltages up to 1,000 volts. Test for value, leakage, dielectric absorption and

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Exclusive high potential testing to 1000 volts in a portable tester. Isolate leakage problems fast with an unheard of portable 1,000 volts. A new power circuit gives you all the power you need, yet still gives you 9 hours of portability on one battery charge.

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- Finds Distance To Within Feet Of Open Or Shorted Transmission Lines
- Tests SCRs, Triacs, Hi-Voltage Rectifiers, Diodes, With SCR250 Accessory
- Checks Leakage As Low As One Microamp Up To 600 Volts In Cables, Switches, PC Boards, And Connectors

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Test inductors in or out of circuit with the time proven Z-Meter inductance tests. The LC75's double patented inductor tests check for true inductor value, and tests

the effective quality of the coil with a special ringing test, in or out of circuit. Find shorted turns and problems that "value only" testers can't find. The patented ringing test even finds just one shorted turn. Just push the button and read inductor value from 1uH to 10H and read the quality of the inductor with 100% reliability.

Check for insulation breakdown and troublesome leakage paths in areas where isolation is critical. The LC75 is a hi-potential leakage tester for testing switches, PC boards, connectors and contacts. Read

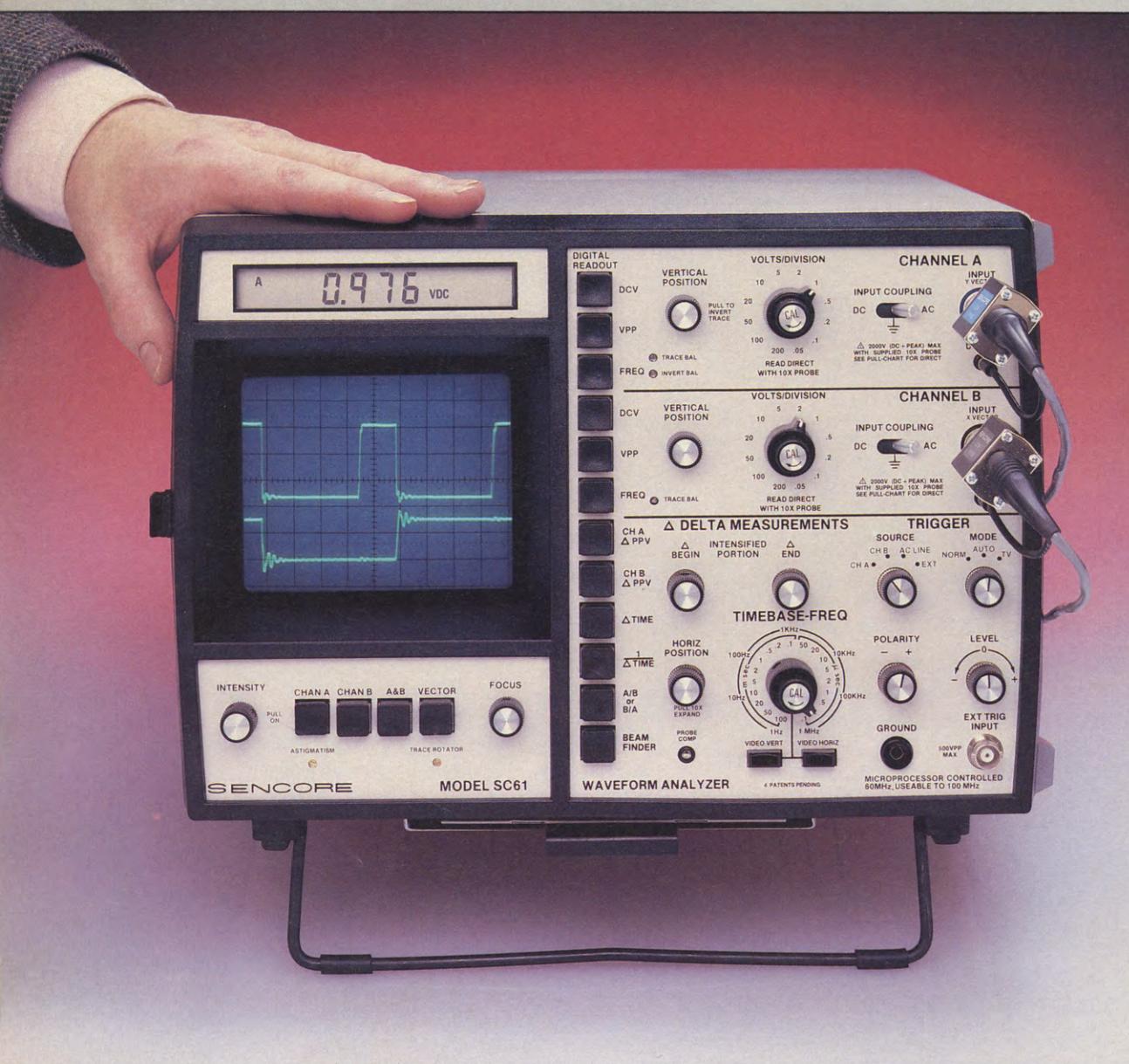


leakage as low as one microamp at voltages as high as 600 volts.

Eliminate costly errors. The LC75 allows you to locate potential problems that otherwise could go undetected, and cost you money down the line. The LC75 is autoranged, so it's easy to use, and has a handy pull chart to guide you in your testing. For your safety, and to keep from damaging sensitive components, the LC75 flashes a warning when 50 volts or more is applied to a device. Capacitors are automatically discharged when the leakage button is released.

SC61 Waveform Analyzer™

60 MHz (usable to 100 MHz) Dual Trace Waveform Analyzer



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At first glance the SC61 Waveform Analyzer may look like an ordinary conventional oscilloscope: high performance, dual trace, 60 MHz bandwidth (usable to 100 MHz). But when you pick up the probe and connect to a test point, that's when the SC61's special ECL sync circuits and auto-tracking digital readout begin working for you to save you valuable time and effort.

There are other scopes on the market that have digital readouts, but none of them have completely eliminated graticule counting, interpretation and extra lead hook ups. The SC61 was designed to integrate the features of a high performance scope with exclusive sync circuits and digital display to give you automatic, rock solid measurements through one probe. You simply hook up the probe to the circuit, then view the locked in waveform on the CRT. To read DC voltage, peak-to-peak voltage, and frequency of the waveform you simply push a button and read it directly on the auto-ranged LCD digital display — all through one probe, and without interpretation. It obsoletes other scopes like the calculator obsoleted the slide rule.

The SC61 Waveform Analyzer also gives you exclusive DELTA functions that allow you to analyze any part of a waveform in just seconds. Measure peak amplitude of part of a waveform, time of an event, or frequency of part of the waveform. Now you can easily locate the source of ripple on DC supplies, catch the frequency of a small glitch, or check the duty cycle on a digital waveform. Just lock in the waveform on the CRT, and adjust the DELTA BEGIN and DELTA END to intensity

the portion of the waveform you need to analyze. Then simply push a button and read out the corresponding peak-to-peak voltage, time or frequency. It makes troubleshooting defective waveforms easy, so you can locate the problem circuit quickly.

It's high performance. The SC61 gives you 60 MHz usable to 100 MHz bandwidth to troubleshoot even the latest digital circuits. The SC61 also gives you dual delayed signal trace so you can see the leading edge of the waveform on both channels. You can also add, subtract or view both channels separately.

It's digitally accurate. The SC61 Waveform Analyzer eliminates inaccurate and frustrating graticule counting. The internal microprocessor monitors the signal that is applied to the CRT, and digitally tracks the important parameters you need. Peak-to-peak volts, DC volts and frequency. You get measurements that are 10 times more accurate than conventional scopes.

Its waveforms are rock solid. The SC61 Waveform Analyzer, with its special circuitry, has the ability to lock quickly onto waveforms all the way to 100 MHz. This has been achieved through exclusive ECL (emitter coupled logic) circuits in the front end and noise cancelling differential amplifiers throughout the sync circuits. The SC61 Waveform Analyzer provides "rock solid" sync that allows you more time to troubleshoot, and less time fiddling with the trigger control to lock in a waveform.

Analyze Waveforms Easily

- Accurate Waveform Display — 60 MHz Bandwidth (Usable To 100 MHz) To Test The Latest Digital Circuits
- Rock-Solid Sync — ECL Logic Circuits And Differential Amplifiers Give Fiddle-Free Operation
- Four Times The Measuring Range — Measure From 5 mV To 2000 Volts (3000 Volt Protection) For Expanded Signal Handling

AUTOTRACKING™ Digital Readings Analyze The Whole Signal

- Autoranging DC Volts Through Single Probe, Even AC Coupled
- Automatic Peak-To-Peak Volts — Even If Variable Control Is "Out Of Cal"
- Automatic Frequency Measurements Without Sensitivity Adjustment Or Range Switching

Delta Digital Tests Analyze Any Part Of The Signal

- Delta Peak-to-Peak Volts — Peak-to-Peak Volts Of Any Part Of The Signal
- Delta Time For Any Time Reading — Including Delay Between Traces
- 1/Delta Time — Or Frequency Of Part Of The Signal — Finds Sources Of Interference Or Ringing

Frequency Ratio Test — Tests Multiplier And Divider Circuits

Easy To Use — Human Engineered Controls And Virtually No Graticule Counting Or Calculations

SC61 Waveform Analyzer

\$3295 Patented U.S. Funds



On GSA Contract
NSN 6625-01-169-2318

It safely handles 4 times the signal level of any conventional scope. Most conventional scopes are able to handle only up to 600 volts on their input circuitry. The SC61, however, provides you with 5mV to 2000 volts (protected to 3000 volts) measuring ability to give you the extra versatility you need. Perform high voltage measurements without worrying about overloading the front end and causing you additional expense and down time.

Plus many extra high performance features. Post deflection, high intensity, blue phosphor 8 X 10 cm CRT provides easy-to-view trace, even under high ambient lighting conditions. • IEEE488 Bus Compatible. • Push button X-Y vector display with 4 MHz response for accurate phase comparisons. • Z-Axis input. • Beam finder. • TV Vertical and TV Horizontal video preset positions with sync separators.



FS74 CHANNELIZER SR.™ TV-RF Signal Analyzer

New Technological Breakthrough!



- All Channel Digital Tuner — Tunes In Any Cable, HRC, ICC, VHF, UHF, And FM Channel From 5 MHz - 890 MHz.
- Exclusive 5 Microvolt (-46 dB) Sensitivity With Automatic Attenuation And Ranging For Fast Hands-Off Operation
- Exclusive Automatic Tests, Even On Fully Modulated Channels:
 - Audio-to-Video Carrier Ratio Test
 - Hum Test On Any In-Use Channel
 - On-Channel Signal-to-Noise Test
 - Digital Readout Of Frequency Offset
- Exclusive Picture Quality Check With Integrated Wide Band Video Monitor — Isolates Problems Meters Can't Show
- Exclusive ACV/DCV Measurements Through RF Input Or Special DVM Input — No Need To Carry Additional Test Instruments

FS74 CHANNELIZER SR. TV-RF Signal Analyzer

\$3495 Patented

U.S. Funds

On GSA Contract

Now, locate any problem in any CATV, SMATV or RF distribution system quickly and accurately, plus test to full FCC specifications. The FS74 gives you every test you'll need to FCC specifications. RF level, Signal-to-Noise, Audio/Video separation and Hum tests are performed 100% automatically. Plus, the FS74 has an exclusive wide-band monitor that allows you to see system problems and trace them to their source.

Tune in all cable, off-air and FM channels with digital ease and accuracy. The FS74's digital tuner lets you tune in all sub-band, cable, VHF, UHF, and FM frequencies that range from 5MHz to 890MHz. The FS74 also gives you a special AFT that locks onto the exact carrier frequency and displays the amount of offset to 1kHz resolution. HRC and ICC offset lets you track cable system shifts at the flip of a switch.

Super sensitivity brings in the weakest signals with 100% automatic attenuators. The FS74 gives you 5

Thoroughly Analyze And Pinpoint Any RF Video Distribution System, Accurately And Automatically, In 1/2 The Time, Or Your Money Back

microvolt sensitivity that allows you to troubleshoot back to the head-end or antenna. The RF input is fully autoranged. The FS74 automatically selects the proper attenuator range so you can measure signal level instantly, from -46 dBmV to +60 dBmV.

Microprocessor control makes all performance tests fast and simple. Exclusive microprocessor technology allows all tests to be performed on any in-use channel without removing or decreasing modulation, or adding special carriers. A patented signal-to-noise test automatically compares the signal level to the actual in-channel noise level. Making audio-to-video level tests are simple. The FS74 automatically tunes both carriers and automatically reads out the separation in dB. Hum tests are made directly also, another Sencore exclusive.

Exclusive built-in wide band monitor gives you picture quality checks anytime, anywhere. The FS74's integral

wide-band monitor lets you see tough system problems like ghosting and interference and track them quickly to their source. Just turn on the monitor and view any channel in full detail. The 4 MHz bandwidth means you can isolate problems that would go unnoticed on a portable TV.

Built-in autoranging AC/DC voltmeter and ohmmeter means you'll never be caught short. Your troubleshooting edge is enhanced with AC and DC voltage measurements and a special low range ohmmeter right at your fingertips. Plus, measure up to 200 volts AC or DC right through RF input!

We guarantee the FS74 will cut your RF distribution System servicing time, or your money back. Call 1-800-843-3338 and locate system problems faster than you imagined possible.



FS73 CHANNELIZER JR.™ TV-RF Performance Tester



Make Difficult Performance Tests In Any RF Distribution System 100% Automatically

- All Channel Digital Tuner — Tunes In Any Cable, HRC, ICC, VHF, UHF, And FM Channel
- Exclusive 5 Microvolt (-46 dB) Sensitivity With Automatic Attenuation And Ranging For Fast Hands-off Operation
- Exclusive Automatic Hum And Signal-to-Noise Tests On Any In-use Channel
- Microprocessor Controlled Fine Tuning With Readout Of Frequency Offset

Now You Can Completely Performance Test Every Single TV Channel, In Any RF Distribution System, To FCC Specifications, 100% Automatically And 100% Faster Than Ever Before.

Discover fully automated performance tests on all channels to FCC specifications. The FS73 CHANNELIZER JR. gives you the same performance tests that its big brother, the FS74, offers you. RF

level, Signal-to-Noise, Audio/Video separation and Hum tests are performed 100% automatically on any channel. No more tuning to unused carriers for your performance tests.

FS73 CHANNELIZER JR.
TV-RF Performance Tester
\$2395 Patented

U. S. Funds

On GSA Contract

New Technological Breakthrough!



Super sensitivity and digital tuning make performance tests quick and easy. Measure from -46dBmV to +60dBmV with autoranged attenuators; eliminates error prone "attenuator pads." Plus, you can test all channels from 5MHz to 890MHz.

Automate your system tests. A special IEEE 488 interface allows you to computer control your performance test for remote and long-term monitoring with the optional IB72 interface accessory.

Call WATS Free 1-800-843-3338 17

CR70 "BEAM BUILDER"™

Universal CRT Analyzer and Restorer

Test Every CRT On The Market — Now And In The Future — Plus Restore 50% Of All Weak Or Shorted CRTs . . . Or Your Money Back. (Includes Color/ B & W TVs, Scopes, Computer Displays, Camera Tubes And More.)

- Test Every CRT (Old or New) — No Need To Buy Additional Sockets
- Exclusive Tests Cover CRT's Full Dynamic Range, From Cutoff To Peak Emission — For Highest Test Reliability
- Guaranteed To Safely Restore 9 Out Of 10 Weak Or Shorted CRTs — Or Your Money Back
- Guaranteed To Be Totally Protected From Damage From Charged CRTs — Keeps Your Investment Working For You

CR70 "BEAM BUILDER" Universal CRT Analyzer and Restorer

\$1295 Patented U.S. Funds
On GSA Contract
NSN 6625-01-187-4395

"The CR70 is a great instrument and has saved us money on camera tubes."

Eddie H. Sills
Chief Engineer (Maintenance)
Roswell, New Mexico

Stop wasting valuable time and profits by replacing CRTs. Today's electronics in the latest TVs are getting more and more reliable, but there is still one area of the TV that is guaranteed to fail, the CRT. However, most CRTs that do fail can be successfully restored with a reliable restoring system. The CR70 gives you the most reliable system anywhere that allows you to restore tubes that you would otherwise replace. The CR70 is a breakthrough in CRT restoration, here's why . . .

Test every CRT on the market. The CR70's unique selectable switches, universal adaptor and its wide restoration current range allows you to test every type of CRT in use today.

- All B & W and Color Video CRTs
- Projection CRTs
- Computer Display CRTs
- Closed Circuit Video CRTs
- Camera pickup tubes - broadcast, industrial and surveillance
- Even scope, radar and other industrial CRTs

You'll never have to buy another socket again. There are thousands of different types of CRTs that are being used today, and with them comes a lot of different socket configurations. However, most of the CRTs use one of ten basic designs in their socket basins. The pins might change position, but the general design stays the same. The CR70 takes advantage of this fact by allowing you to select the pin configuration with switches, rather than having to buy a new socket. Simply connect the socket that fits the neck, and select the grids, filaments and cathode with the selectable switches. If you do run across an "oddball" CRT, the CR70 gives you a universal adaptor that allows you to connect and test those non-standard CRTs.

Dynamic tests you can trust. The CR70 tests the CRT over its entire operating range, from black (cutoff) to white. It's the only tester that does. The CR70 tests emission as "true beam current" (current that passes through the control grid to the screen grid). Plus, its exclusive cutoff test accurately identifies CRT problems related to bad contrast that other testers miss. A patented color tracking test gives a direct good/bad

comparison of all three guns of a color CRT or all three CRTs of a projection system to confirm they will balance properly for any color or B & W picture. The CR70 also tests for shorted elements.

Restore CRTs safely and effectively. Many technicians know what a conventional CRT rejuvenator can do to a CRT. Most of the time it's "push the button and pray." The CR70's exclusive controlled current system means you never again have to worry about losing a CRT again by zapping it too hard. The CR70 is guaranteed to restore 9 out of 10 weak or shorted CRTs. This saves you thousands of dollars by extending the life of the CRT compared to replacing the CRT, or by restoring a CRT that is no longer available. Only the CR70's progressive restoration gives you this ability.

Full protection from overload damage. Many CRT testers are damaged by the high voltages left on the CRT. The CR70 is fully protected, however, to eliminate the possibility of this with special MOVs (metal oxide varistors).

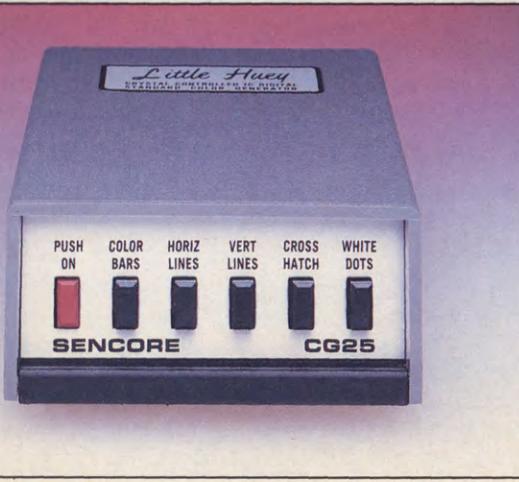


CG25 Little Huey™

Portable, Digital Color Bar Generator

Rock Solid Digital Patterns In A Small Portable, Battery Operated Package

- Built Rugged For Field Use — With Built-In Test Leads
- Big Generator Features With Variable Dot And Adjustable Channels
- Automatically Shuts Off After 20 Minutes So Your Batteries Don't Run Down



Rock-solid digital patterns: Just push the buttons for jitter-free standard color bars, horizontal and vertical lines, crosshatch, and white dot patterns.

Built rugged for field use: Lasts and lasts on the road with tough acrylic case.

Big generator features: Dot size, color level, and RF channel controls just like the deluxe generators.

CG25 Little Huey \$198 U.S. Funds
On GSA Contract

FC71 Portable 10 Hz To 1 GHz Frequency Counter™



The Only Portable, Battery Operated Counter Especially Designed With An Exclusive Microprocessor Controlled Timebase To Measure 10 Hz To 1 GHz To 0.5 PPM Accuracy In High RF Environments

The only truly portable 1 GHz counter that makes every reading better than FCC requirements. The FC71 uses a unique, new, microprocessor-controlled timebase. This patented counter provides (0.5 ppm/yr aging) from 10 Hz to 1 GHz. With the 8 1/2 digit LCD display, you get superior accuracy on the high end while allowing .01 Hz resolution for low end and audio work.

Since there is no power robbing oven, the FC71 gives nine hours of continuous operation. Take it wherever it's needed: broadcast towers for FCC documentation, repeater sites for troubleshooting, or airplane cockpits for avionics tests.

The most sensitive frequency counter available allows you to count signals other counters miss. The FC71's 5 mV input sensitivity lets you count signals in more circuits than with any other counter - without external amplifiers. It will even measure the output of RF

generators and communications monitors that can't be tested with other counters.

The highest stability available lets you count the toughest signals. The FC71 is guaranteed to be the most stable counter you can buy. Its uniquely designed input circuits allow you to count signals that are otherwise unmeasurable. Signals like AM or FM, digital signals with ringing, or signals with noise. The FC71's stability means you never have to guess at frequencies again.

Fully RF shielded so you can measure anywhere, even in high RF fields. With most counters, you cannot make measurements near a broadcast or 2-way transmitter because the counter picks up the transmitter signal through the case. The FC71's double shielding lets you measure signals in RF fields that are impossible to measure with other counters.

FC71 Portable 10 Hz To 1 GHz Frequency Counter \$1295 Patented U.S. Funds

On GSA Contract
NSN 6625-01-076-2695



Additional tests make the FC71 more than a counter. An exclusive frequency-ratio test simplifies troubleshooting in digital and RF multiplier and divide circuits. Simply measure the input, press the frequency store button, measure the output, and push the ratio read button to find the exact ratio. The FC71 also has a unique crystal test to check any crystal at its fundamental operating frequency to eliminate guesswork in oscillator repairs.

IEEE 488 instrument bus interface automates the FC71 for extended tests. Sencore's optional universal IEEE interface, the IB72, allows you to use the FC71 with a computer for automated testing and data collection. Perform system stability tests over long periods of time, or document frequencies in quality control tests.

TF46 Portable Super Cricket Portable Transistor/FET Tester



Test Any Transistor Or FET With 99% Reliability In Less Than 15 Seconds — In Or Out Of Circuit

- Portable Battery Operation So You Can Completely Analyze A Transistor Or FET Anywhere
- Needs No Set-up Book Or Instructions
- Automatic Power Shut Off After 20 Minutes Use; Saves Your Batteries

On GSA Contract
NSN 6625-01-058-9564

TF46 Portable Super Cricket Portable Transistor/FET Tester \$495 Patented

U.S. Funds

Instantly test any transistor or FET without set-up books. The TF46 is the latest in a long line of "cricket" testers that gives you a patented "good" or "bad" test in or out of circuit. The TF46 is completely automatic, simply hook up the three leads in any configuration, and the TF46 tells you if the device is good or bad with an audible chirp, and on the meter. It also identifies the transistor's base, emitter and collector, or the FET's gate, drain and source.

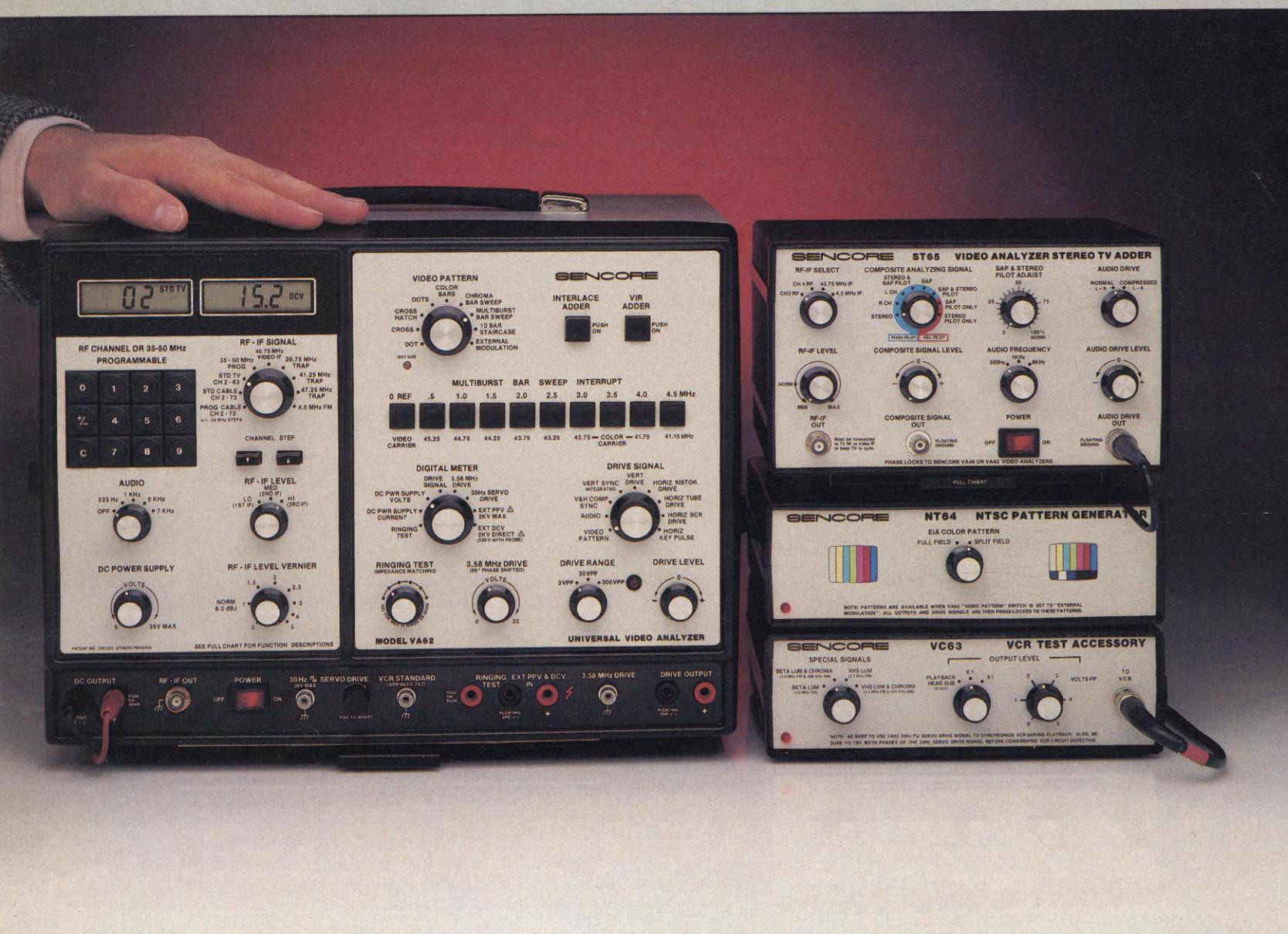
Test for gain at the push of a button to match transistors and speed troubleshooting. The TF46 also allows you to test for leakage on transistors that show good gain, but have leaky collector-to-base or collector-to-emitter junction. Plus it has a diode test too, for more versatility.

Trademarks of Sencore, Inc.: Little Huey, Super Cricket, MICRORANGER®, POWERITE®, Waveform Analyzer, AUTOTRACKING, BEAM BUILDER, CHANNELIZER JR., CHANNELIZER SR., PORTA-Z, AUTO-Z.

Pricing Note: All prices shown are U.S. dollars. Canada must add applicable Duty, Freight, and F.S.T. Prices and specifications subject to change without notice.

Call WATS Free 1-800-843-3338

VA62 Video Analyzing Package



The Only NTSC Video Servicing System Guaranteed To Cut Your Servicing Time By 54% Or Your Money Back.*

Isolate Video Troubles In Half The Time With The Only Universal Video Analyzer.

- Identify Tuner Problems With All-Channel, VHF, UHF, And Cable RF Generator
- Pinpoint IF Troubles With Modulated Troubleshooting Signal And Exclusive Programmable IF/RF Generators
- Isolate Any Video Problem With Patented Video And Standard Color-Bar Patterns
- Find Defective Stages, Without Disconnecting Parts, Using Exclusive Phase-Locked Drive Signals
- Test Yokes And Flybacks, Plus Measure Signal Levels With Autoranged Digital Meter
- Expandable; Update For New Technology With Exclusive Phase-locked Accessories

VA62 Universal Video Analyzer \$3495 Patented U.S. Funds

On GSA Contract
NSN 6625-01-187-5516

The VA62 Universal Video Analyzer is the only system that equips you for successful servicing in the expanding video market. It ends expensive parts substitution (especially when working with large-scale ICs) and eliminates embarrassing, costly callbacks by allowing you to quickly, confidently, and dynamically check every repair.

Eliminate aggravating tuner questions. The all-channel VA62 gives you the confidence of complete RF testing. The "Standard TV" generator produces every VHF and UHF channel, the "Standard Cable" generator every cable channel and "Programmable Cable" function lets you duplicate any cable carrier shift to test lock in range.

Dynamically isolate IF troubles quickly and easily. The VA62 isolates any IF trouble with a fully modulated, crystal referenced 45.75 MHz IF signal, matched to inject into any IF stage. Both video and audio modulation identify any trouble. It's a real troubleshooting confidence builder.

Patented signals let you set IF traps—a must for cable—by simply looking at the CRT. Plus, the VA62 lets you do full IF alignments without confusing cables or complicated adjustments.

Isolate troubles without disconnecting a single component with VA62 drive signals. No need to unsolder components because the VA62's output circuits automatically "swamp out" the original signal before injecting the substitute signal. These special

signals let you troubleshoot any video or sync stage, as well as vertical or horizontal circuits. Separate drive outputs allow simultaneous injection into the tricky closed-loop servo circuits or color oscillators.

Digital Meters Add Confidence:

Ringing Test: The digital meter makes the VA62 a complete analyzer. Start by testing deflection yokes and flyback transformers, in-or out-of-circuit, with Sencore's reliable (patented) good/bad ringing test.

Drive Level Monitor: Internal monitoring measures the true peak-to-peak level of any drive signal to prevent overdriving and to show when feeding into a shorted component.

Peak-to-peak and DC Meter: Autoranged external meter includes peak-to-peak and DC to a full 2 kV. Compare peak-to-peak and DC directly to the schematic.

DC Power Supply: The 0 to 35 volt DC power supply blocks confusing feedback loops in AGC, AFT, ACC or servo circuits or isolates problems in direct coupled (DC) circuits, such as vertical amplifiers.

Integrate phase-locked accessories into your video analyzing system to increase your service potential. The accessory jack and the composite video output let you add new technology as you need it. Phase-locking means the accessory signal returns to full sync when used with the other VA62 signals.

* Based on a nationwide survey of users who reported an average time savings of 54% compared to their previous test equipment.

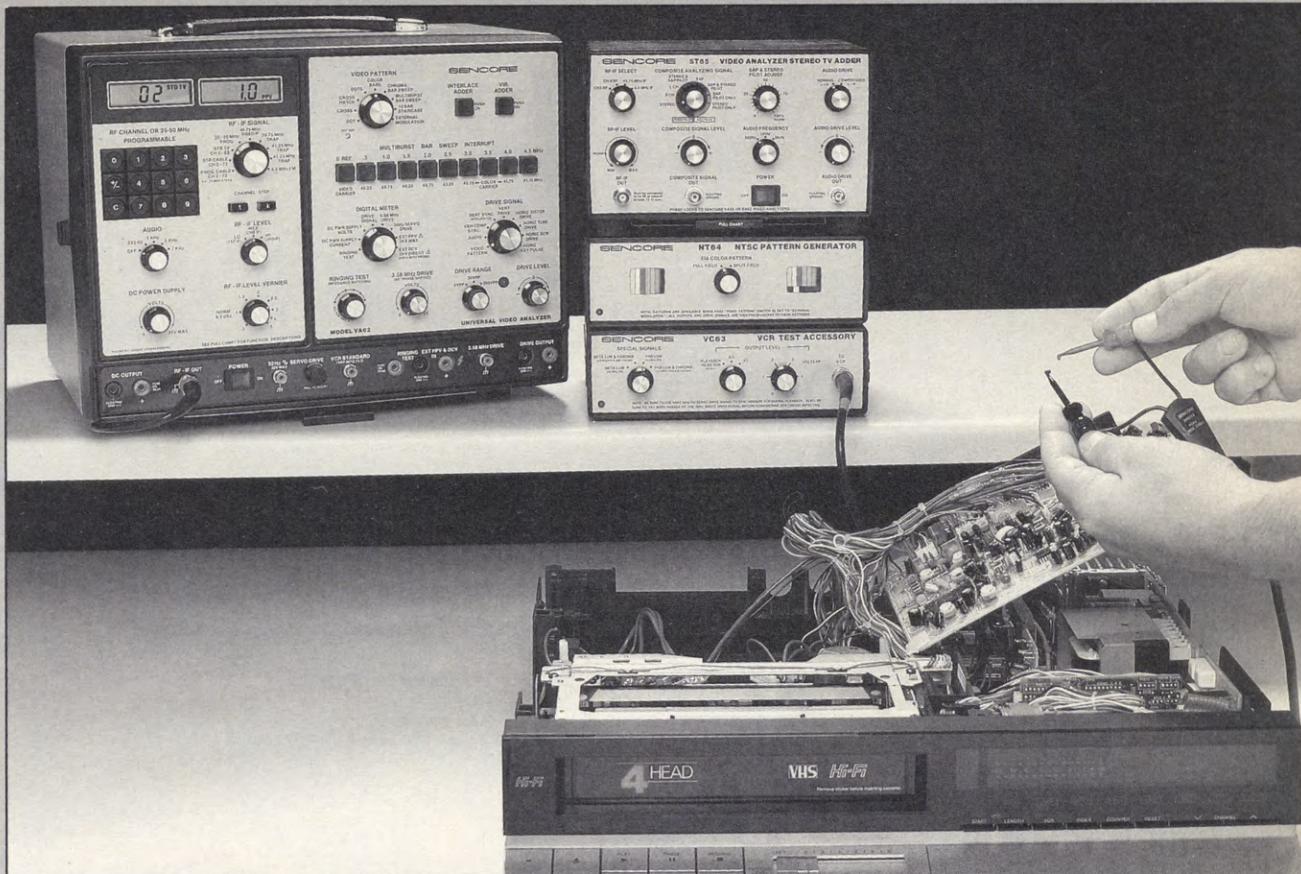
VC63 VCR Test Accessory™

Solves The VCR Service Challenge With Substitute VCR Signals. Phase-Locked To Your VA62.

Find defective heads without expensive substitution in VHS, Beta, and U-Matic VCR formats. Plus, pinpoint defective stages with exclusive substitution signal and troubleshoot color problems with special reference signal.

VC63 \$495 U.S. Funds

On GSA Contract
NSN 6625-01-201-2880



NT64 NTSC Pattern Generator™

For Faster Service And Warranty Approval. Adds NTSC Full Field And Split Field Patterns To Your VA62.

Produces the EIA RS 189 standard full-field and split-field color bar patterns that meet all VCR manufacturer's requirements for a color bar generator. These two patterns are fully phase-locked to all other VA62 signals. The NT64 is one-fifth the cost of competitive stand alone NTSC generators.

NT64 \$495 U.S. Funds

On GSA Contract

ST65 Video Analyzer Stereo TV Adder™

Test, Troubleshoot And Verify Any Mono/Stereo Sound Or SAP Channel - In 1/2 The Time, Or Your Money Back.

Update your VA48 or VA62 Video Analyzer to an integrated Multichannel Television Sound (MTS) Stereo TV analyzing system. The ST65 makes stereo and second audio program (SAP) performance tests on any MTS stereo TV system. Exclusive adjustable RF/IF, COMPOSITE SIGNAL, and AUDIO levels match and isolate troubles in any stage — including the decoder. It's the only tester guaranteed to tie troubles down to any and all stages.

ST65 Video Analyzer Stereo TV Adder \$995 Patent Pending U.S. Funds

On GSA Contract

RG67 NTSC Video Monitor Adaptor

Updates Your VA48 or VA62 Video Analyzer With Every R, G, B Combination Required For Analog/Digital Monitor Service.

The RG67 provides phase-locked R, G, B, and I signals to drive any NTSC analog or digital monitor. Match any input with selectable signal and sync polarity and adjustable amplitude to 5 VPP. Fast hookup to R, G, B and I inputs with E-Z HOOK® leads.

RG67 \$890 U.S. Funds
On GSA Contract



SR68 Stereo TV Readout™

Tests Any Stereo Output To 100 Watts, With Power, Separation, And Signal Level Measurements.

Analyze stereo TV Audio Line or speakers in dB or watts. Loads to 100 watts provide dynamic testing and speaker substitution. Automatic channel separation measurements to -40 dB without calculations. The SR68 is battery operated—use in the shop or in the field.

SR68 Stereo TV Readout \$595 U.S. Funds

On GSA Contract

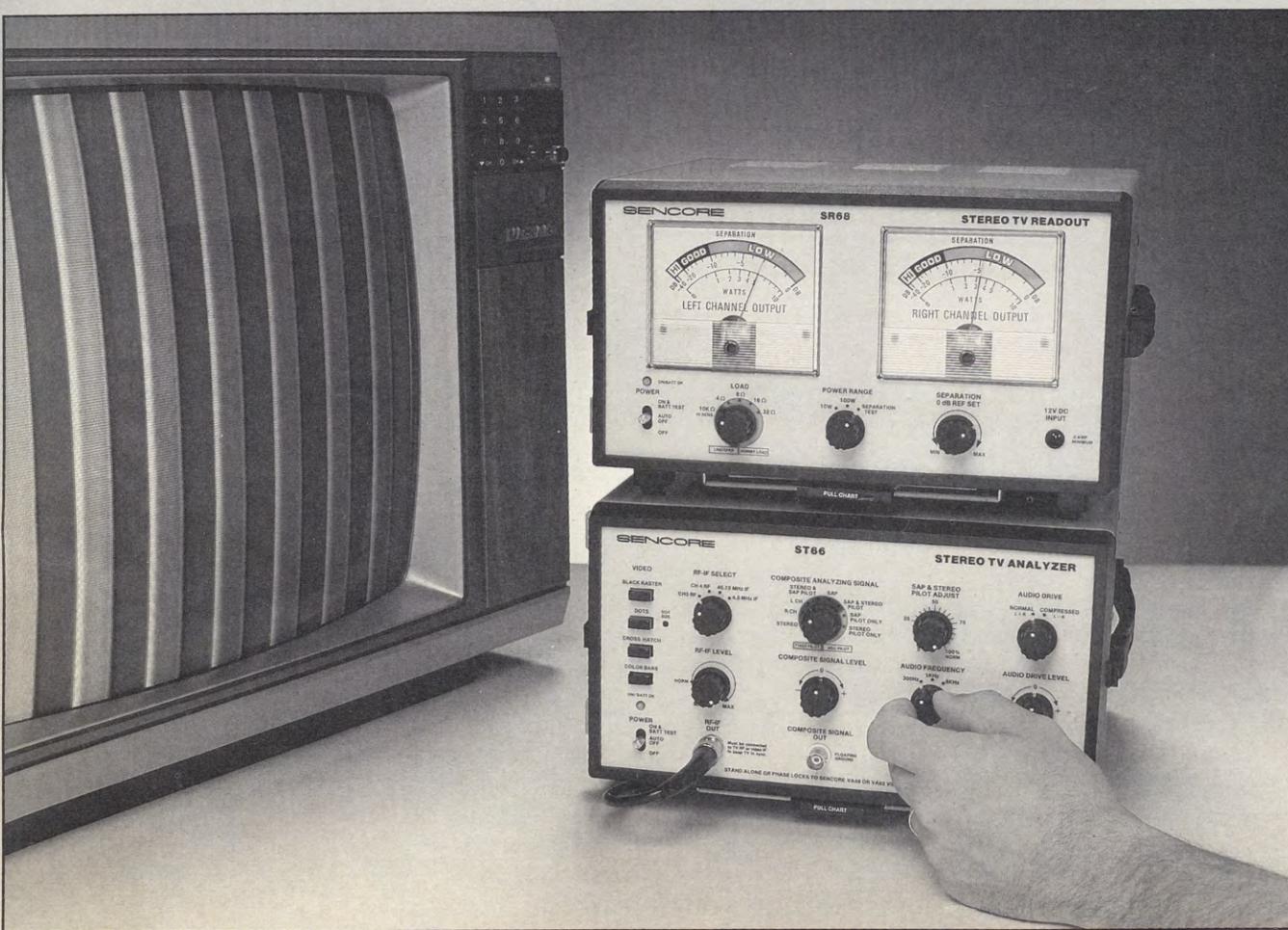
ST66 Stereo TV Analyzer™

Test And Troubleshoot MTS And Cap Circuits Plus Performance Test The Entire TV - Anywhere.

The ST66 is a complete MTS stereo TV and VCR analyzer that provides all of the special signals you need to successfully service MTS stereo TV from the antenna to the speakers with one simple connection. It has exclusive video patterns for total analysis and variable pilots for threshold testing. Plus it's portable—works two hours continuous on one battery charge.

ST66 Stereo TV Analyzer \$1395 Patent Pending On GSA Contract
U.S. Funds

Call WATS Free 1-800-843-3338 21



PR57 "POWERITE"

Variable Isolation Transformer And Safety Analyzer

One Totally Integrated Supply That Lets You Know That Your AC Power Is Right And Safe

The PR57 "POWERITE" lets you know your AC power is right and includes a variable isolated 470 Watt power transformer to isolate your AC line and vary the output voltage from 0 to 150 volts. You'll monitor voltage, current, and wattage to prove that the equipment under test isn't drawing too much current at any voltage setting.

Variable output supply is isolated for your protection. The "POWERITE" 470 Watt AC variable output transformer provides a continuously variable output voltage from 0 to 150 volts; a must for troubleshooting shutdown circuits. It protects you and your test equipment from shocking overloads by isolating you (and the equipment under test) from the AC line.

Solve challenging shutdown problems and eliminate callbacks. Lower the line voltage to solve tough shutdown problems. Raise the line voltage to sweat out intermittents or sensitive parts. Test every

- Variable Isolated 470 Watt Power Transformer To Isolate Your AC Line And Vary Your Output Voltage From 0 To 150 Volts

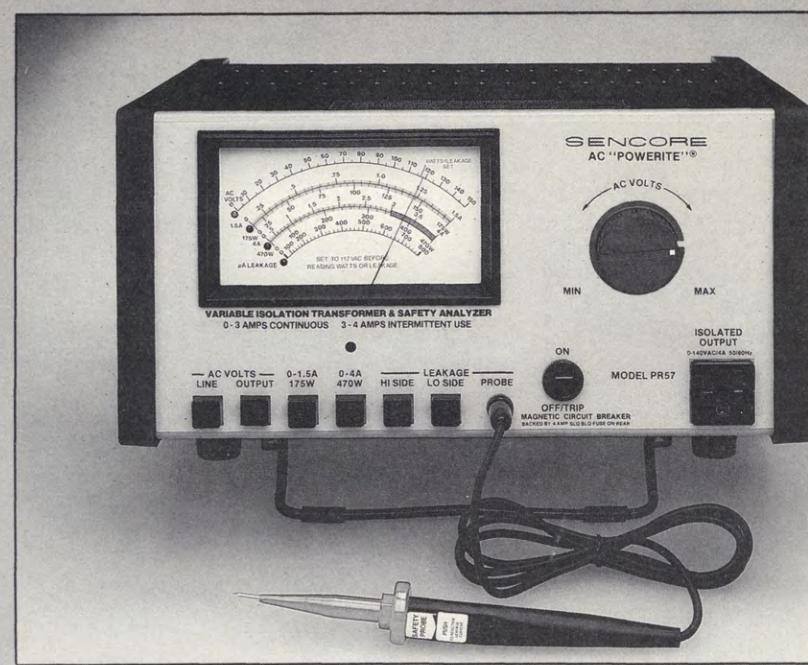
- Voltage, Current, And Wattage Power Monitor To Determine That The Equipment Under Test Is Not Drawing Excessive Current (Or Wattage) At Any Voltage Setting

- AC Line Leakage Safety Tester To Assure That Excessive Leakage Current Is Not Present On Any Exposed Part On The Equipment Being Tested

PR57 "POWERITE"®

\$495 Patented U.S. Funds

NSN 6625-01-124-6296



set at high or low line voltage to avoid embarrassing callbacks. Identify AC line related problems like picture width, sync, and intermittents in the customer's home or test in the shop at their line voltage.

Safety leakage test means safe repairs and additional profits. Safety checks for current leakage are

easy with the PR57's patented tests. Leakage tests are now required from all manufacturers, and you decrease your liability and increase your profits when you perform this test. Since it's a service you offer, you can charge \$3 - \$5 to perform the test, and make a profit on a quick, but vital test.

DVM37 3 1/2 Digit, 0.1% Bench/Portable Digital Multimeter™

Fully Protected, Super Rugged Digital Multimeter You Can Use Anywhere

One super rugged digital voltmeter for every use. If you like to use one meter and use it everywhere and anywhere, you'll want the super, reliable DVM37. You can drop it, kick it, carry it by the test leads, and it will keep right on operating at lab accuracy.

Fully protected inside. Unheard of 8 kV transient protection on every function and range, including ohms means unmatched internal protection.

0.1% DCV accuracy into 15 Megohm input. 15 Megohm input impedance means 50% less loading than other meters with 10 Megohm input impedance. Therefore, you get 50% greater accuracy than other 0.1% DVMs.

DVM56A "MICRORANGER"® Digital Voltmeter

A 100% Automatic, Microprocessor Controlled, Speed & Accuracy, 3, 4 or 4 1/2 Digit DVM, Designed to Save You Time.

- 100% Error Proof, You Can't Make A Mistake, Even If You Operate Everything Backwards

- The DVM56A Makes Tests For You That No Other Single Meter Can Make

- Tough, Fully Protected To 10 kV, Better Than Any DVM On The Market

**DVM56A "MICRORANGER"®
Digital Voltmeter \$995 Patented** U.S. Funds

- An Indestructible DVM For Both Bench And Field
- 0.1% Lab Accuracy In A Portable Meter For Measurements You Can Count On
- 15 Megohm Input Impedance For Least Loading Error Especially In High Impedance Circuits
- Protected Inside, Too, Better Than Any Other DVM On The Market, To 2 kV DC With 8 kV Transient Protection And To 10 kV With TP212 Probe

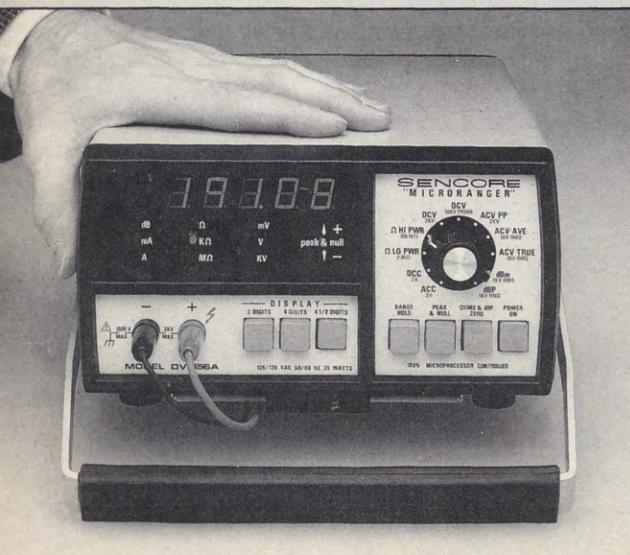
DVM37 3 1/2 Digit, 0.1% Bench / Portable Digital Multimeter \$395 U.S. Funds

The most versatile meter on the market. If you want the best, then the DVM56A "MICRORANGER" is the meter for you. The DVM56A gives you all the tests you'd ever want to perform with a DVM. The internal microprocessor automatically ranges the "MICRORANGER", and gives you these exclusive tests:

- AC and DC current up to 20 amps with the optional CS233 current shunt
- High and low power resistance
- .075% accurate DC to 10 kV
- AC Volts peak-to-peak
- AC Volts true RMS
- AC Volts average RMS
- dBm and programmable dB

Super accuracy and error-free readings every time.

4 1/2 digit readout with .075% DCV accuracy. 15 Megohm input impedance means less loading and more accurate tests. Microprocessor control means no errors.



We Are Dedicated To Helping You Towards A More Successful Servicing Future!

WATS FREE Access



One number, **1-800-843-3338**, connects you to a factory full of friendly people dedicated to making you and your business more successful. Our receptionist will quickly connect you to

your Sales Engineer, Service Technicians, and Application Engineers for technical support, at no added expense to you. Simply pick up the phone and call.

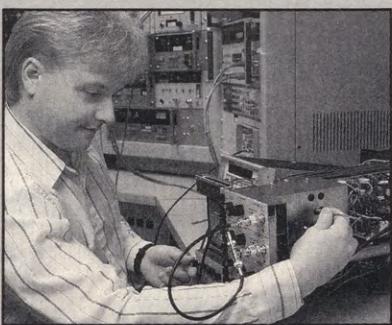
Technical Sales Engineers



Keep up-to-date with changing technology, find out what's happening in the industry by just picking up the phone and calling your Sales Engineer. Get help on instrument comparisons and

register for seminars. Plus, your Sales Engineer will assist you in setting up your shop and save you money on the Sencore instruments you want.

Quality



NBS traceable standards guarantee your instrument is calibrated with readings that are 100% right. Sencore keeps prime standards on site, rather than secondary standards. Only

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In the past 16 years at Sencore, Greg has talked with thousands of servicers and held over 800 service seminars. In this article, Greg stresses an important business concept that is troublesome for many servicers: "Service is important to your customer, charging for service is important to your success." —Editor's note.

"CRT restoring and safety leakage testing — two value-added services that can increase your profits and give your customers peace of mind."

I've always been surprised at how bashful some servicers are when it comes to charging for service. Sometimes the only billing is for parts used and the labor directly associated with changing the part. They don't charge for alignment or safety tests. They may not charge for estimates. They may avoid value-added services, such as CRT restoring, which can increase their income while satisfying the customer.

Can you imagine a medical doctor who charged like many servicers do — a doctor who didn't charge for service? He wouldn't charge to look inside, or to thump, or to test with a machine, or to consult with a specialist. His billing would be pretty low, wouldn't it?

An attorney would have even a rougher road. He or she rarely delivers a product. If attorneys were like some servicers, they might only feel justified in charging if they filled out a form or wrote a will or contract. But they would not charge for advice. And, they would be reluctant to send a bill for winning a case in court, since they only talked, instead of providing something you could slip into your pocket.

Or, think about the parallel industry of automobile repair. If mechanics were as reluctant to charge as many in electronic servicing, we would only pay for the parts installed, and a little labor to install them. But, the mechanic wouldn't charge us to "scope" an engine, or to set the timing, or to pull a wheel to see if our brake shoes are worn to the rivets.

Each of these people sells a few parts or some other product we can see, but the main thing we are buying is their training, experience, and good judgment. That's why good doctors live well. That's why successful lawyers drive nice cars. That's why automobile service centers stay in business. They charge for each service they provide.

Learn The Secret To Proper Billing

The secret to billing is charging a fair price for the services provided. This does not mean "over charging" the customer. It means charging the customer according to the amount of experience and equipment needed to do the job correctly. In

Billing For Value-Added Services Brings You Higher Success

by Greg Carey, CET, Application Engineer

some cases, that includes a separate charge for value you've added through extra service the customer may not get elsewhere. By separating these charges on your invoice, you're reminding your customer that you've provided these extras.

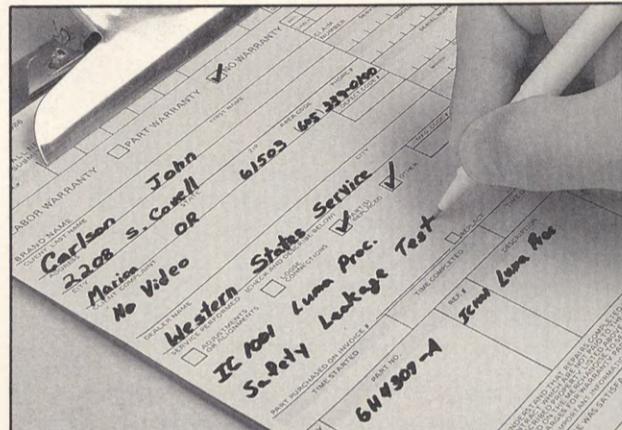


Fig. 1: Some servicers bill only for the parts and labor needed for a repair, and forget to add extra charges for value-added services provided.

If you haven't taken a look at your billing practices lately, you might be using decade-old rates. It might help to look at a professional pricing service, such as the Sperry-Tech (P.O. Box 5234, Lincoln, NE 68505) pricing manual. These services help you track your profitability, and guide you for pricing on parts and labor for any area of consumer service.

Investing in equipment with value-added capabilities also lets you improve your profits.



Fig. 2: The use of a pricing service helps improve billing by reminding you to charge a fair price for all of the different services provided.

Two of these "value added" services are AC safety testing and CRT restoring. Let's see how each of these helps improve your bottom line and your customer's peace of mind.

Safety Leakage Testing Protects Your Customers And Builds Profits

Imagine the chill that runs down the spine of a housewife who reads a story about a child who was injured by a television which was recently repaired. Even though the accident happened hundreds of miles away, it hits home. Imagine her looking at the TV set you shop recently fixed—wondering if it too may be a shock hazard to her child. Now, imagine the peace of mind she would have if you had "safety certified" the set as part of that repair. How much is that added peace of mind worth?



Fig. 3: The value added to your service with the PR57's AC safety leakage test takes only seconds, but gives your customer peace of mind and improves your billing.

Service companies charge typical rates falling between \$3.00 and \$7.00 per unit for performing this all important safety test. That charge covers your time and the added equipment needed to do the job right. The instrument you need to do safety leakage tests is the Sencore PR57 AC "POWERITE"® Variable Isolation Transformer & Safety Analyzer. It has a patented test which lets you make the industry-required safety test on every set, quickly and easily.

For your safety and convenience, the PR57 lets you make the test while the set you are testing is connected to the isolated output. The PR57 comes with a complete promotional kit to let you document every unit you service. The kit includes stickers to place on the finished product and an ad mat you can use to print up flyers or run in local newspapers.

The safety test applies to every television, VCR, stereo, microwave, and AC-operated telephone unit that you service. If you finish an average of 6 products each day, and you charge \$3.00 for the safety test, that means an added \$18.00 income each day. Multiplying \$18.00 times 5 days per week yields \$90.00 each week. If you average 50 weeks per year (2 weeks for vacation), you have increased your shop income by \$4,500.00!

CRT Beam Building Also Adds Extra Profits—Often From "Throw-Away" Products

A second profit opportunity to consider is CRT restoration. Today, many service companies find

that it provides income from TV receivers that are too old for a new CRT, but too good to throw away. Others find that projection TVs are creating a brand new CRT service market.

The popularity of restoring and rejuvenating has gone through several cycles through the years. About a decade ago, CRT restoration was sold as a way to "sell more new picture tubes." You guaranteed your work, so that the customer would come back to you for a new CRT when the restoration wore out. As the price of new CRTs increased, and the cost of new sets dropped, this didn't work as well. The customer would throw the set away, instead of paying for a new CRT.

Today, restoring is rarely tied to CRT sales. It may give the customer the added time they need to fit a new set into their budget. Or, restoring the tube may give them a second set to use in the basement or the kid's room, while a new color receiver gets priority in the entertainment center.

Restoration is also important when you've finished a major repair, such as a flyback replacement, and find a weak picture. Now, you have to convince the customer to pay for the relatively expensive parts and labor, and accept a poor picture besides. Restoring the CRT produces a much better picture than before the flyback went bad. This brings extra income, and a happier customer as well.

Projection sets give even more reason for restoration. Often, one of the three CRTs becomes weak before the other two. Normally, changing one CRT means changing all three tubes, since the two stronger tubes will not provide the same output light level as the single replacement. So, the question for the customer is one of changing all three tubes, or continuing to run with one weak tube. Restoration of the weak tube lets you balance it with the other two and return an acceptable picture.



Fig. 4: Restoring a CRT with one of the 5 levels of Progressive Restoration of the CR70 "BEAM BUILDER" lets your customer keep an older set running, while generating value-added billing for you.

You Can Test Every CRT On The Market — Now, And In The Future, Plus Restore 90% Of All Weak Or Shorted CRTs

Older CRT rejuvenators often don't have enough power to improve the picture, or else they damage CRTs with too much power. In either case, you cannot depend on restoration to satisfy your customer or to generate added income. That's where the "Progressive Restoration" offered by Sencore's CR70 "BEAM BUILDER" CRT Analyzer and Restorer makes all the difference. It gives the balance between safety and effectiveness needed to profit from CRT restoration.

Only Sencore gives you a dynamic cathode test at both the cutoff and the maximum beam-current levels. This test is more scientific than units that lump everything into a single "emission" test, so that you can correctly use Progressive Restoration. You start with "AUTO RESTORE", the lowest, safest level. If it improves the CRT, stop. You've done the job with the least risk to the CRT cathodes.

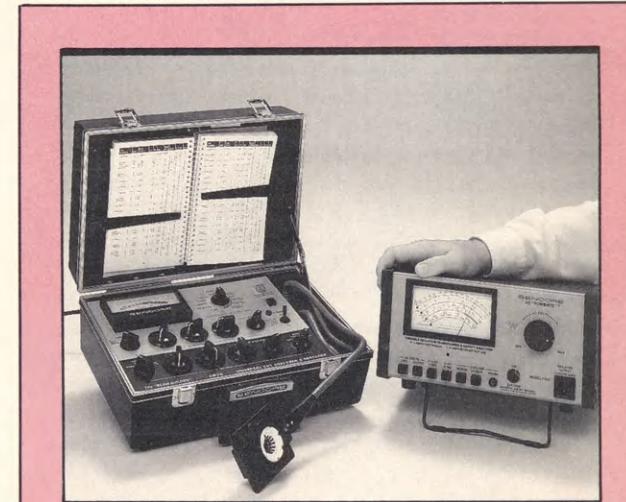
If the tube still checks bad, you can step up to the manual positions or use a shot of capacitive-discharge rejuvenation. The results are an improved picture in 90 out of 100 bad picture tubes. (NOTE: The 10 that do not improve are usually tubes whose cathodes have been stripped by old-fashioned CRT rejuvenators, tubes with direct metal to metal shorts, or tubes with an air leak which caused complete cathode failure.)

Unlike safety testing, you cannot apply a restoration bill to every set you service—most don't need it. But, since the charge is higher, your profits still add quickly.

Let's say you only restore two CRTs per week, at a charge of \$35.00. Multiplying \$35 by 2 by 50 weeks produces additional billing of \$3500 per year. At only \$1295 for the CR70, your investment brings back a 170% return in the first year—something most investment bankers cannot even dream of.

As you can see, it only takes a few of these added services to bring your company's profits up by a measurable amount. Most Sencore products have similar value-added tests which can help in other areas. For example, many servicers charge to do a performance test with their VA62. Others use their ST65 or ST66 Stereo TV Analyzers to generate extra billing. You improve your success by billing for the services you provide—even if they didn't involve soldering in a part. This extra income from service can pay for all kinds of improvements for your business—new test equipment, a new sign, improved tools, or just plain bottom-line profits and higher income.

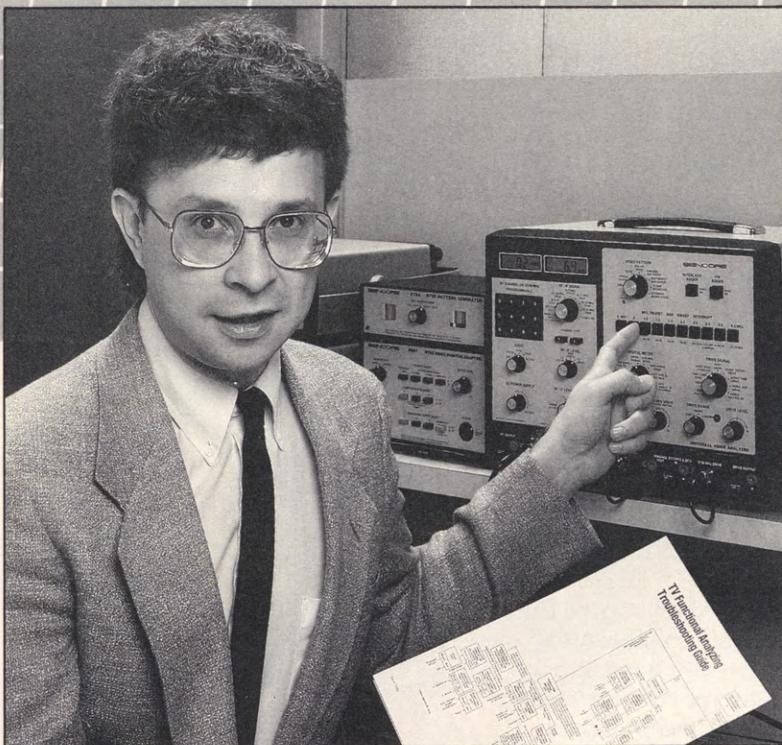
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How The VA62 Universal Video Analyzer™ Simplifies Video Troubleshooting

By Greg Carey, Applications Engineer, CET

Unfortunately, video problems aren't always as simple as an open transistor. Sometimes, they involve problems buried deeply inside an IC. At other times, all of the circuits work marginally, but the defect is restricting either signal amplitude or frequency response. At still other times, a defect in one stage causes the DC levels in several adjoining stages to be incorrect, making conventional voltmeter tests difficult.

Functional Analyzing With Your VA62 Universal Video Analyzer Simplifies Troubleshooting.

These are the kind of problems which are simplified with the organized and universal troubleshooting methods offered by functional analyzing with your VA62 Universal Video Analyzer.

Many VA62 owners use its full analyzing capabilities on tougher problems. They use their old troubleshooting methods on "easier" problems. For example, they may depend on their voltmeter or transistor tester instead of using the time-proven method of injecting fresh signals at one test point at a time until a single defective stage is isolated. Yet, the VA62 can very well make these common troubles even easier to find.

A good example of this is in the luminance (black and white) circuit path, which includes the video IF stages, video amplifiers, and the picture tube. A "dead" luminance stage may be caused by a problem in a tangential stage, such as a blanking or sandcastle circuit. Your VA62 confirms this right away, rather than having to move through a number of trial and error tests.

Functional analyzing means you use the *function of the circuit* to narrow the problem to one stage before you ever pick up a scope or a meter probe. You already know that you are looking in the right circuit, so you don't need to worry about feedback, control, or loading in one stage from giving you misleading information. To make this easier to follow, let's look at the typical problems you have to find.

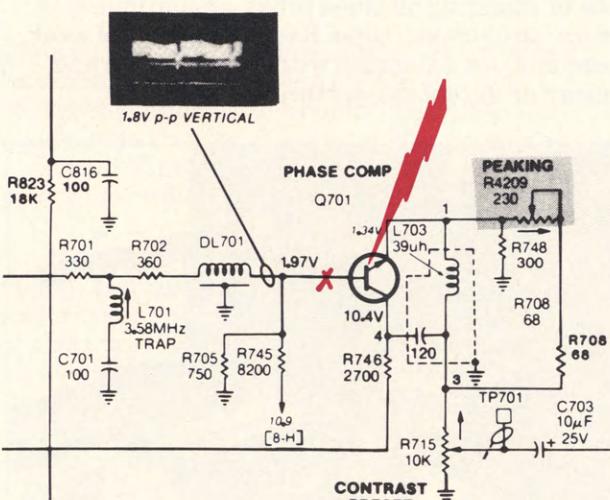


Fig. 1: Some video problems, like open transistors, are easy to find compared to problems which simply reduce the quality of the picture.

If, for example, a video amplifier transistor opens, you can find the problem using any of several test methods. You might use your DC voltmeter, and take readings on each transistor starting at the picture tube and working back toward the input. The open transistor will usually show incorrect voltages.

Or, you could take the same approach with a scope. You would find no AC signal from the picture tube back to the output of the bad transistor. The input of the transistor will show a healthy signal, confirming you are very near the bad stage.

You could even find this problem using a transistor tester with good in-circuit accuracy, such as the Sencore TF46 SUPER CRICKET. All of the transistors would check okay, except for the one that was open. Changing the transistor would then clear up the problem.

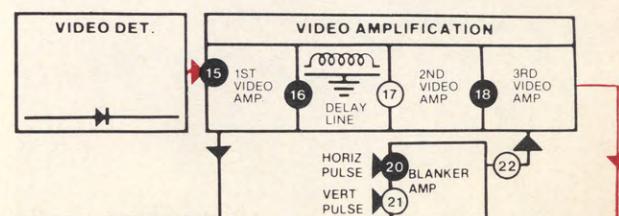


Fig. 2: Use the universal block diagram, supplied with your VA62 Universal Video Analyzer, to guide your testing of any of the circuits in the luminance (black and white) path.

Symptom	Possible Causes
No Picture	Video Amplifier Transistor or IC Power Supply Picture Tube Blanking Pulse Sandcastle Video IF Video Detector Tuner
Poor Contrast Or Brightness	Picture Tube Video Amplifier Transistor or IC IF Gain Video Detector Tuning Power Supply IF AGC Automatic Brightness Limiter Room Light Sensor
Bandwidth Limits	Peaking Coil Trap Settings IF Tuning (S.A.W. Filter) Coupling Capacitor Automatic Fine Tuning Power Supply

Fig. 3: Even "simple" symptoms might involve several suspected bad stages. The VA62 lets you confirm which stage is causing the trouble, so that you only have a few components to test.

Video Problems Are A Challenge For Servicers

Video symptoms fall into three general categories:

- 1) No picture
- 2) Poor brightness or contrast
- 3) Poor resolution or detail

Each symptom can be caused by several different problems, so your troubleshooting efforts must separate one likely cause from another.

No Picture: A complete loss of picture may not even be in the video circuits. Power supply problems, bad picture tubes, missing blanking signals, and other problems may cause the screen to go blank. The "Sandcastle" signal, found in many receivers which use integrated circuits for the video amplifiers, can also cause an apparent loss of video—even though the video circuits all work correctly.

Poor Contrast or Brightness: These symptoms are usually caused by problems in the IF or video amplifier stages. But, there are tangential paths which could be involved in these problems too. For example, the AGC circuits (which are actually part of the IF circuits) may cause poor gain. Or, automatic brightness limiters or room-light sensors may be involved. These tangents, however, don't stray far from the main luminance path, so the VA62 helps find these problems almost as quickly as problems in the main circuit path.

Bandwidth Limits: Symptoms like harsh edges, smear or lack of detail indicate a circuit with poor frequency response. These problems are in some straight-line circuits. The biggest trouble with finding these problems is that signal tracing with an oscilloscope is almost useless, since the DC, peak-to-peak, and general waveshape will all look correct. Injecting known-good signals into each test point quickly confirms which stages work and which ones have problems.

With any of these problems, you use signal substitution to quickly isolate the defective stage. You inject a good signal from the VA62 while you watch for an improvement in the symptom on the picture tube screen. If you see an

improvement, you know that all of the circuits from the injection point to the output are working correctly. If the symptoms don't improve, you know that the good substitute signal is passing through the bad stage, so the problem is in a circuit closer to the output.

Connect your VA62 directly to the circuit, right over the top of the existing signal. Special circuits in the VA62 "swamp" out the original signal and replace it, so you do not need to unsolder parts or short out circuits. While the VA62 is swamping the AC portion of the signal, DC blocking circuits are protecting the TV circuits from damage, allowing the circuit to operate under its normal bias.

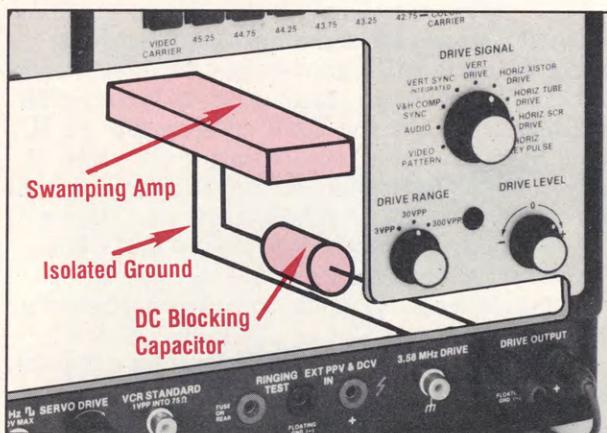


Fig. 4: The VA62 makes signal substitution easy with a unique swamping amplifier, to let you inject right over the top of existing signals, and DC blocking circuits, to prevent damage to the circuit under test.

You continue to zero in on the problem until you find one point where you get an improved picture while injecting at a circuit's output, and see the original symptom when injecting at its input. (NOTE: Remember to set the VA62 for the same signal level as normally found in the circuit. If you inject too much signal, it may force through a bad stage, causing you to make a wrong conclusion.)

The last two defects relate to signal quality. You need a standard for comparison to find them. The VA62's first help comes in the special video patterns provided for testing video quality. The EIA 10-bar staircase video pattern helps you quickly confirm whether the video signals are providing correct response between pure black and pure white signal levels. The exclusive MULTIBURST BAR SWEEP video pattern helps you find problems caused by poor bandwidth, such as smear or loss of detail.

The substitute signals may not help you as much as you think without a clear-cut approach to any video problem. If you want highest effectiveness, you should be able to use an identical approach on every type of TV you service, whether it uses the latest ICs or the oldest vacuum tube design. Luckily, the VA62 gives you this approach, in the form of "trouble trees" supplied with each unit. Let's see how these troubleshooting guides help you get right to the problem.

An Organized Approach Lets You Find Troubles In 4 Steps Or Less

If you are new to signal substitution, the first thing to know is that you use a positive approach instead of the normal subtractive approach used with a meter or scope. Simply stated, you are looking for good stages instead of bad ones. Often times, a half dozen or more suspected bad stages

can all be proven good with a single test, and you don't need to concern yourself with them after that.

For this to work, you want most of the circuits operating under their own power. They need their normal input signal, supplied from the antenna terminals. Remember to leave the VA62 RF cable connected to the antenna whenever you are injecting any of the VA62 drive signals. Signal substitution will not work correctly if you forget to hook up the antenna cable.

You Can Isolate Any Video Problem In 4 (Or Fewer) Troubleshooting Steps

The next important point is to select test points which will group circuits into large blocks, and then zero in on the specific circuit. The main division point in the luminance circuits is the video detector. All of the stages before the detector need modulated signals, and all of the stages after the detector use unmodulated signals. By deciding whether the problem is before or after the detector, you divide the number of suspected bad circuits by a factor of two.

Isolating troubles before the detector uses a different set of VA62 signals than those after the detector. Let's look at how each positively identify the defective circuit. We will start with the circuits after the detector, since the first troubleshooting step uses a drive signal.

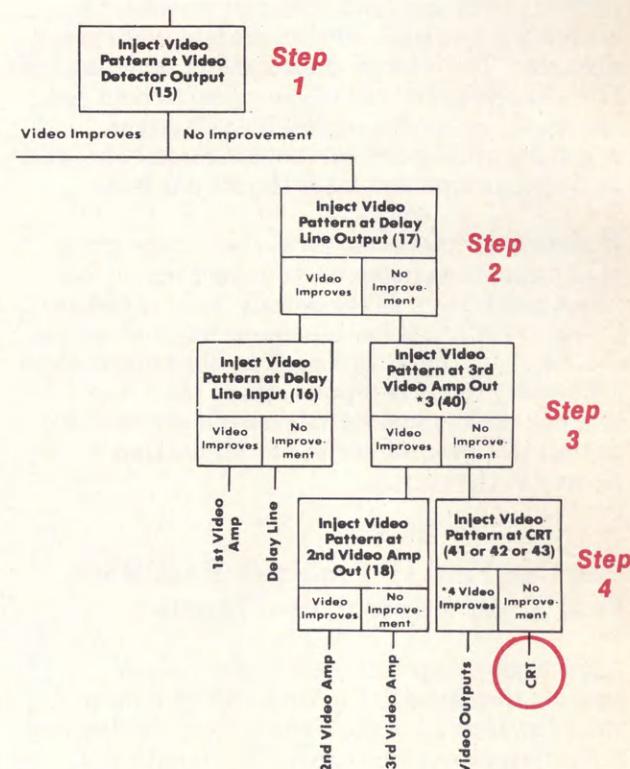


Fig. 5: The troubleshooting guide, supplied with the VA62, shows how to find any video problem in 4 troubleshooting steps or less.

Using The VA62 Drive Signals, You Can Prove Circuits Good Without Disconnecting Parts

The VA62 Drive Signals, adjusted by the controls in the lower, right-hand corner of the panel, are used for any of the video circuits after the video detector. The video amplifiers only need the drive signal called "Video Pattern". This position of the switch produces composite video which duplicates the signal at every test point from the detector output to the cathodes of the CRT.

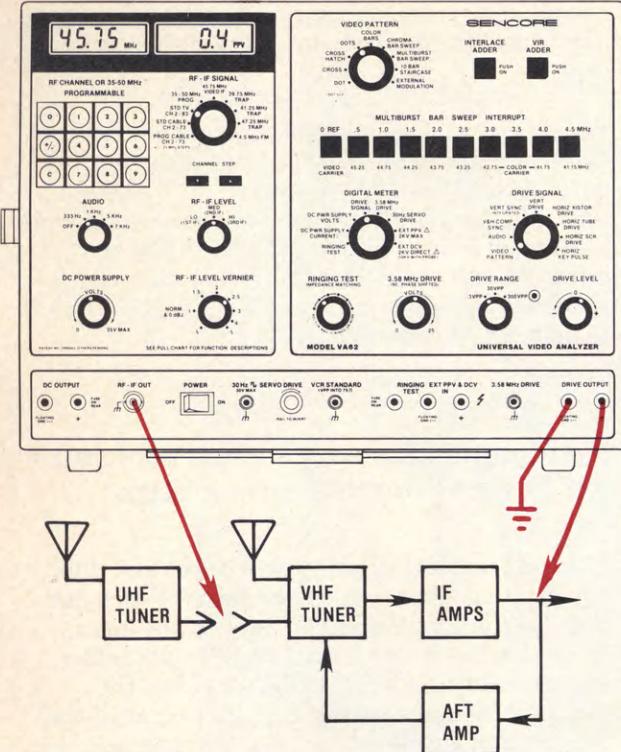


Fig. 6: Use the VA62's Drive Signals to inject into any stage after the video detector, while the RF signal (connected to the antenna) holds all of the other circuits in sync.

Whenever you are using a drive signal, you must keep the antenna connected to the VA62's RF output jack. This holds all of the good circuits in sync with the VA62 video generator while you are injecting into suspected bad stages. Then, adjust the DRIVE RANGE and the DRIVE LEVEL controls until the VA62's output matches the normal peak-to-peak level at the test point you are using. The internal digital meter registers the true peak-to-peak level of the signal to help you set the signal for the correct level. You can sometimes find a bad component directly because a shorted component loads the output level.

If there is no improvement in the picture when you inject at the detector, you must move your inject point closer to the output. Just as before, keep the VA62's RF cable connected, and adjust the VA62 for the correct peak-to-peak level before connecting to the test point. Since the VA62 swamps the original signal, you simply feed the signal right over the top of any signal that's already in the circuit.

You Can Find IF Problems Fast With Your VA62's Substitute Signals

If the video symptom cleared up when you injected the signal at the video detector output, you know that all of the circuits from the detector to the output work correctly. This points to a problem in the detector or the IF circuits. The VA62 has a special generator designed to isolate IF troubles.

The IF troubleshooting generator provides a crystal-controlled 45.75 MHz IF carrier, modulated with the video pattern chosen by the VA62's "Video Pattern" switch. Use the staircase pattern when your symptom involves poor contrast or brightness, or the Multiburst Barsweep pattern if the symptom indicates poor bandwidth.

Older IF circuits (using tubes or transistors) usually had three stages, each with a voltage gain of about 10. The VA62's output attenuator is marked with the appropriate signal level to match the input (the base of a transistor or the grid of a tube) of the first, second, and third IF stages. If you inject the corresponding IF signal, and see a clear picture, you know that the circuits have proper gain from that test point onward.

Whenever you inject a signal into one of the IF stages, you should use the matching transformer (balun) supplied with the VA62. The balun provides the proper impedance matching. The difference between the VA62 balun and a conventional MATV or CATV transformer is the addition of DC blocking capacitors in the transformer's secondary winding to block the DC bias from the circuit, and prevent the transformer from shorting out the injected stage.

By the way, IF stages are the only exception to the rule mentioned earlier about keeping the antenna cable connected. The IF stages are ahead of the point where signals split to feed to the sync, sweep, and color circuits, so injecting into any IF test point feeds all needed circuits simultaneously.

Video IF stages no longer fall into strict first, second, and third IF gain stages. Most, however, still have three main sections: 1) An input buffer amplifier, 2) A passive SAW filter, and 3) An IC containing the main amplifiers and the video detector. You use signal substitution in much the same way as with conventional IF gain stages, except the signal levels don't follow the VA62 panel in the same way, because the majority of the gain takes place inside the integrated circuit.

Fig. 7 shows the normal signal level for a typical IF stage. Notice that all three of the test points use signals in the "Low" range of the VA62 panel. The IC then steps the signal level up to the level needed by the video detector inside the same IC.

Test Point	Tuner Link	Saw Input	Saw Output
Signal Level	Lo 1.2	Lo 5	Lo 1

Fig. 7: When all the stages work correctly, modern IF stages give an acceptable picture with low signal levels right up to the IF amplifier IC.

By comparison, Fig. 8 shows how the normal signal levels change when the stages have problems. Since setting the output control to "MED" produces 10 times more signal than "LOW", and since "HI" produces 10 times larger signals than "MED", the test points ahead of the problem need over 100 times more signal than they normally use. But, test points after the defect operate with normal conditions. A quick check of the required signal levels shows which stage has the poor gain.

As you can see, this gives a dynamic test of each of the components in the IF stages, including the SAW (Surface Acoustic Wave) filter. This special tuned component is best tested in the circuit, by confirming whether its input and output respond correctly to normal signal levels.

Tough Problem Stages Are Easy To Find With Your VA62

So far, we've shown how to use the VA62 to isolate problems that involve circuits in the straight line path from the antenna to the CRT. Signal substitution works just as well when the problem is caused by a circuit off the main path. For example, a bad blanking circuit may cause the picture to be missing. You will find that injecting into the video amplifier after the blanking circuit returns the picture, but injecting ahead of the blanking circuit shows a problem. At that point, you've proven that the problem is

Test Point	Tuner Link	SAW Input	SAW Output
Problem			
Shorted Input Transistor	Hi 2	Lo 5	Lo .9
Open SAW Input	Hi 1.7	Hi 5*	Lo .9
Open SAW Output	Med 1.2	Hi 5	Lo .9

* Picture still not clear with full output

Fig. 8: Notice how much additional signal level is needed when there is an IF problem. You know the IC is good, since it provided a good picture with low signal levels in each case.

related to the amplifier which receives the blanking signal, but you may think that the amplifier itself is bad. This is where you need one more piece of advice, or you might find yourself changing parts that are not actually bad.

Simply remember that the VA62 only tells you that a problem is related to the isolated circuit—not necessarily inside the circuit itself. Be sure you use conventional troubleshooting methods (meters, scopes, transistor testers, etc.) to confirm the bad part before unsoldering anything. But, signal substitution has already confirmed that whatever is wrong is directly involved with the identified stage.

This same basic guideline also applies to any stage which uses an integrated circuit. If you get improved performance when injecting at the IC output, and bad performance when injecting at its input, you know that the problem is related to the IC. But, the problem may not be the IC itself. Be sure you check all the operating signals, supply voltages, grounds, and surrounding parts before changing the IC.

Using signal substitution ensures you the best success when servicing video problems. And, the universal approach of the VA62 means you can use the same methods on any brand or model of TV receiver. It's almost like working on the same model day after day—even if you service many different brands.

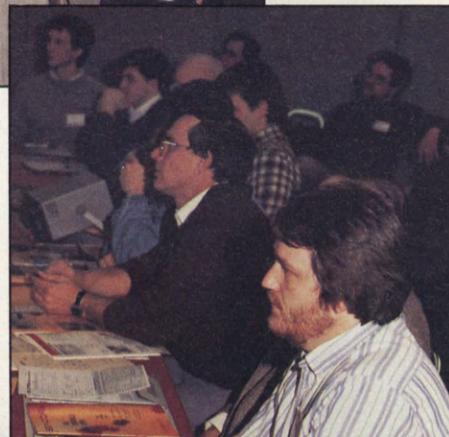
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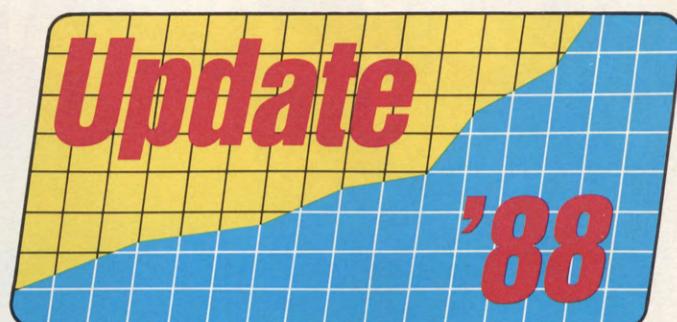
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1988 VCR/TV Servicing Techniques**



What You'll See Demonstrated:

- **How to tame any tough dog VCR/TV problem in half the time:** See a proven troubleshooting technique that is guaranteed to cut your VCR/TV "Tough Dog" troubleshooting time in half.
- **How to isolate frustrating shutdown problems in 5 steps or less:** See how you can locate tough shutdown problems with pin-point accuracy. Exclusive troubleshooting techniques will bring any chassis out of shutdown and turn those "tough to find" shutdown problems into a quick servicing job.
- **How to dynamically analyze any VCR head or head circuit problem with 100% reliability:** See how special substitution signals isolate VHS, BETA, or U-Matic problems with 100% proof positive results.
- **How to walk through any VCR system control problem with a simple 5 step microprocessor troubleshooting technique.**
- **How to determine if a cap or coil is simply good or bad, easily and with 100% reliability:** See how the NEW triple-patented, microprocessor controlled LC77 "AUTO-Z" locates bad caps or coils at just the push of a button.

To Register Call 1-800-843-3338 U.S. or 1-800-851-8866 Canada



1 Call Your Area Sales Engineer to reserve a seat at your scheduled workshop.



2 Check "yes" I plan on attending the Sencore Workshop on the enclosed seminar return card.



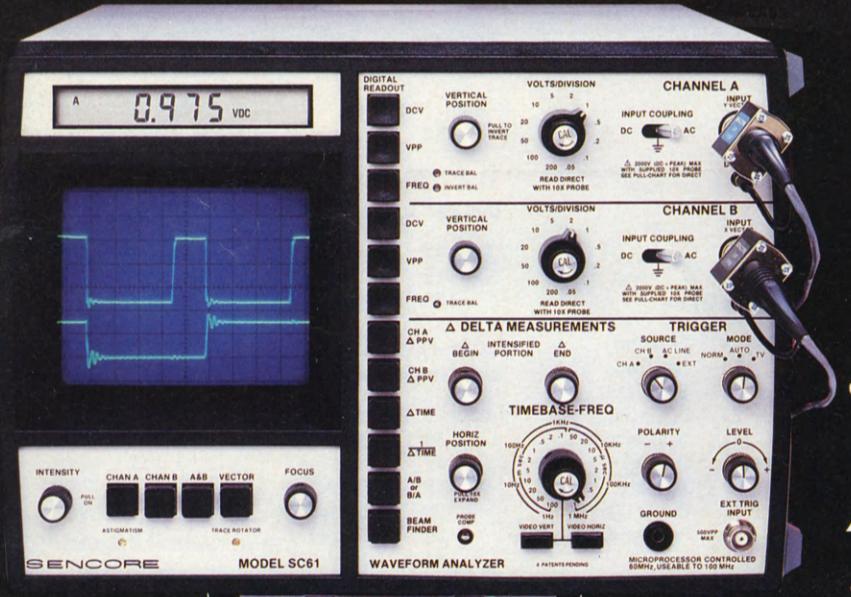
3 Next mark your calendar so you don't forget. Even if you do, we'll remind you a few days before your scheduled workshop. (P.S. Bring a technical friend.)



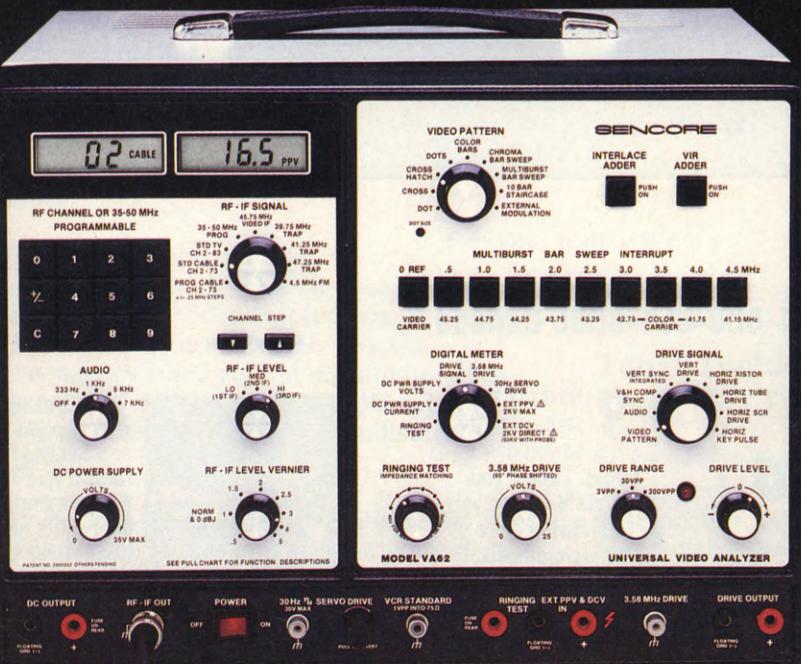
4 Then be sure to attend to receive your Free Sencore Workshop attendance gift — two specially prepared Video Servicing Workbook Study Guides. A \$40.00 value.

Your servicing success is our success. Please join us and your technical friends at Sencore's all new workshops.

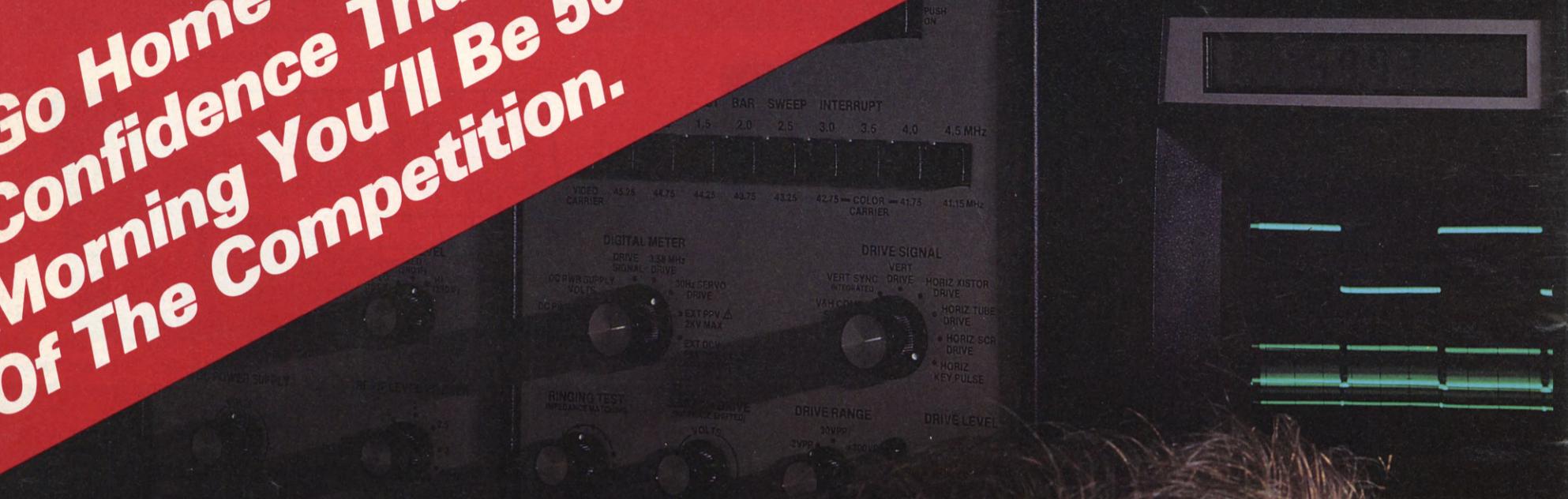
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Of The Competition.**



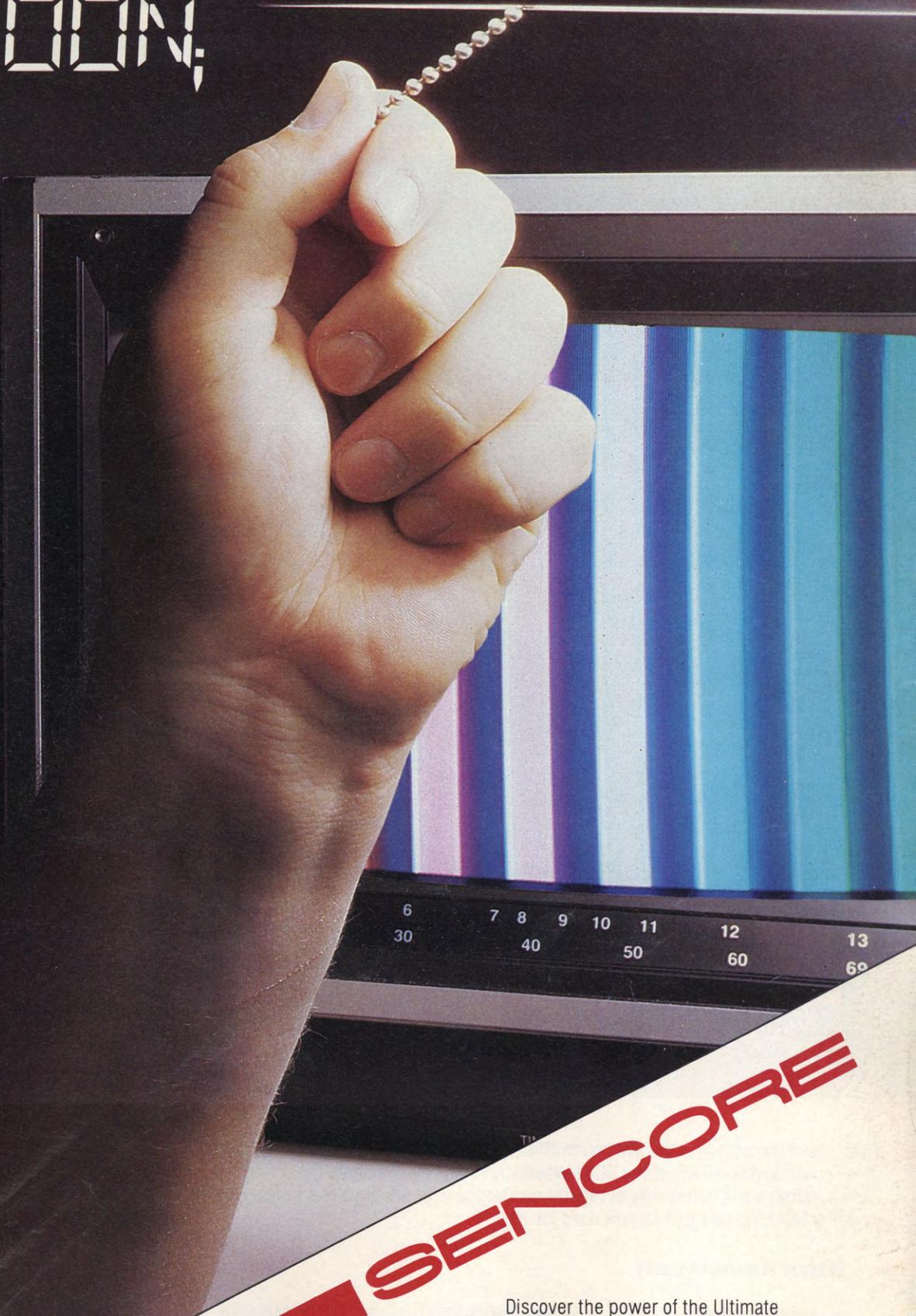
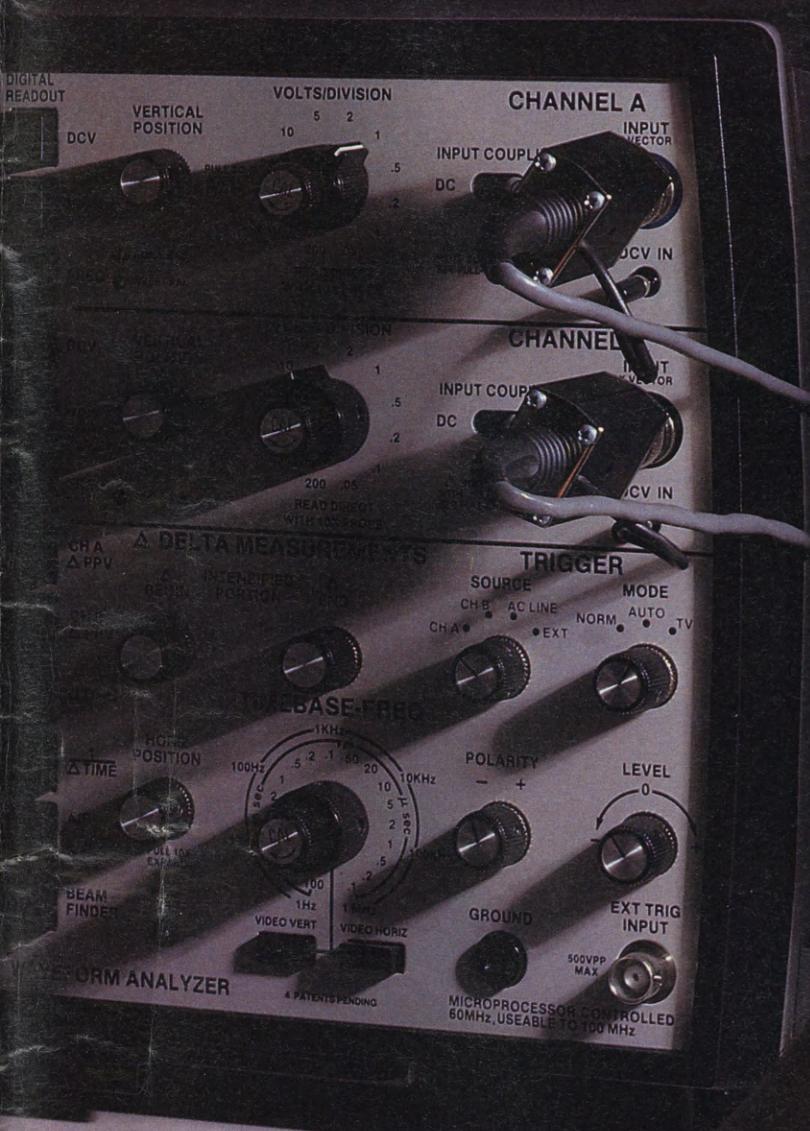
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Or, request additional information on the Update '88 Response Card on page 28.

The Ultimate Troubleshooting Team is backed by our no nonsense 30 day "Proof Of Performance" Guarantee.

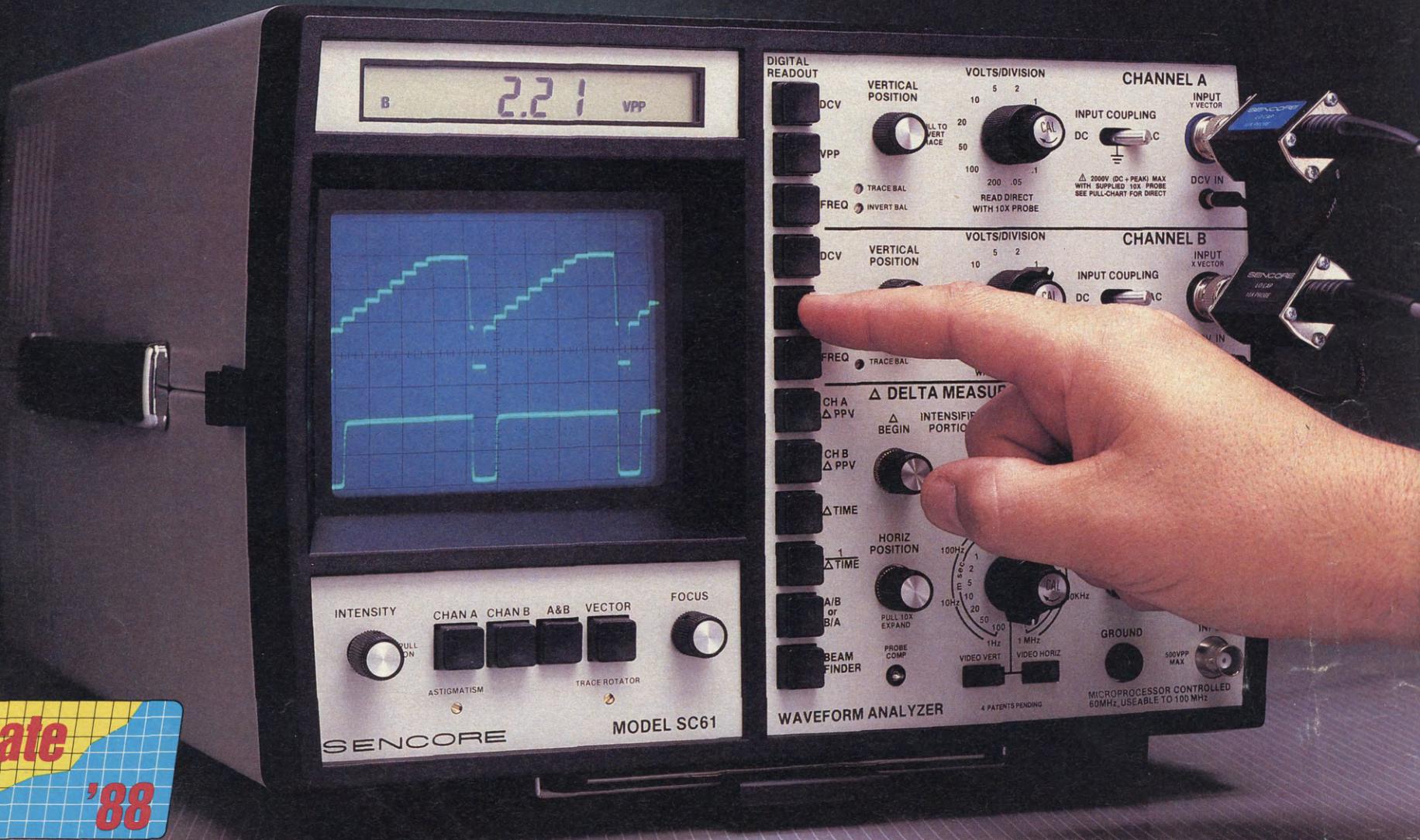
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